US009160697B2

(12) **United States Patent**
Rogers

(10) **Patent No.: US 9,160,697 B2**
(45) **Date of Patent: Oct. 13, 2015**

(54) **DATA DELIVERY OPTIMIZATION**

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(73) Assignee: **QUALCOMM Incorporated**, San Diego, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 787 days.

(21) Appl. No.: **13/342,092**

(22) Filed: **Jan. 1, 2012**

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(51) **Int. Cl.**

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H04L 12/58	(2006.01)
H04L 29/08	(2006.01)
H04L 5/00	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 51/14*** (2013.01); *H04L 5/0058* (2013.01); *H04L 5/0069* (2013.01); *H04L 12/58* (2013.01); *H04L 67/104* (2013.01); *H04L 67/108* (2013.01); *H04L 67/1076* (2013.01)

(58) **Field of Classification Search**

CPC H04L 12/58; H04L 51/14; H04L 5/0058; H04L 5/0069; H04L 67/104; H04L 67/108; H04L 67/1076

USPC 709/206, 218, 219

See application file for complete search history.

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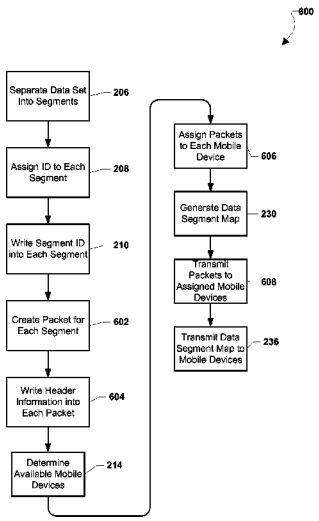
Primary Examiner — David Lazaro
Assistant Examiner — Robert Shaw
(74) *Attorney, Agent, or Firm* — Shirin Tefagh; Joseph Agusta

(57) **ABSTRACT**

The various embodiments provide systems, devices, and methods which optimize the way in which data is delivered between devices a group of interconnected devices. In one embodiment a data set intended for multiple devices may be segmented and different portions of the data set may be provided to each device. The intended devices may then share their data set portions to recreate the complete data set on each device. In another embodiment, multiple devices each storing a complete data set may need to upload the complete data set to a single device. The multiple devices may assign upload responsibility for segments of the complete data set among each other, and the multiple devices may each upload their assigned segments to the single device. The single device may then combine the segments to recreate the complete data set.

75 Claims, 33 Drawing Sheets



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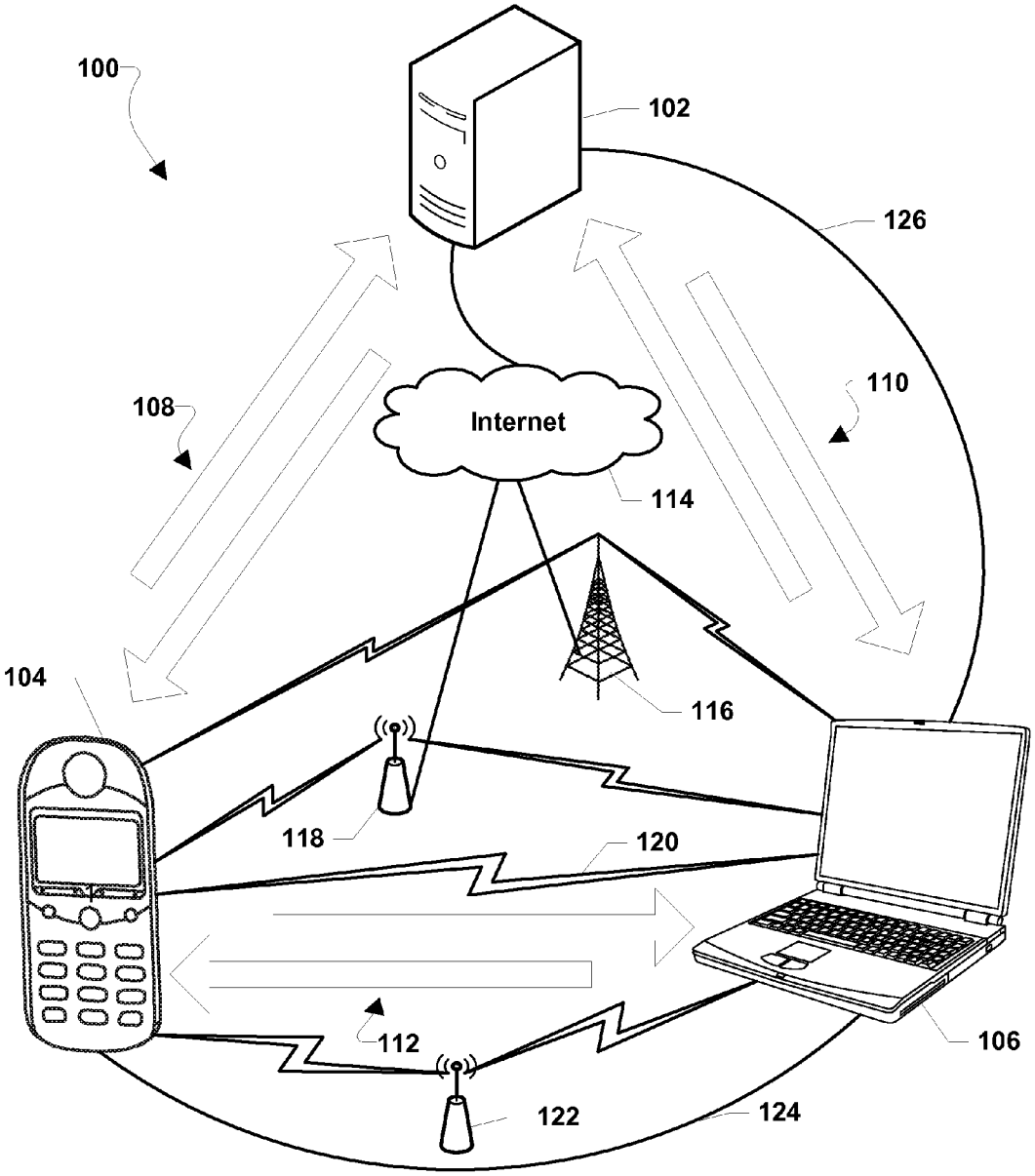
100
102
126
108
Internet
110
114
104
116
118
120
112
106
122
124

FIG. 1

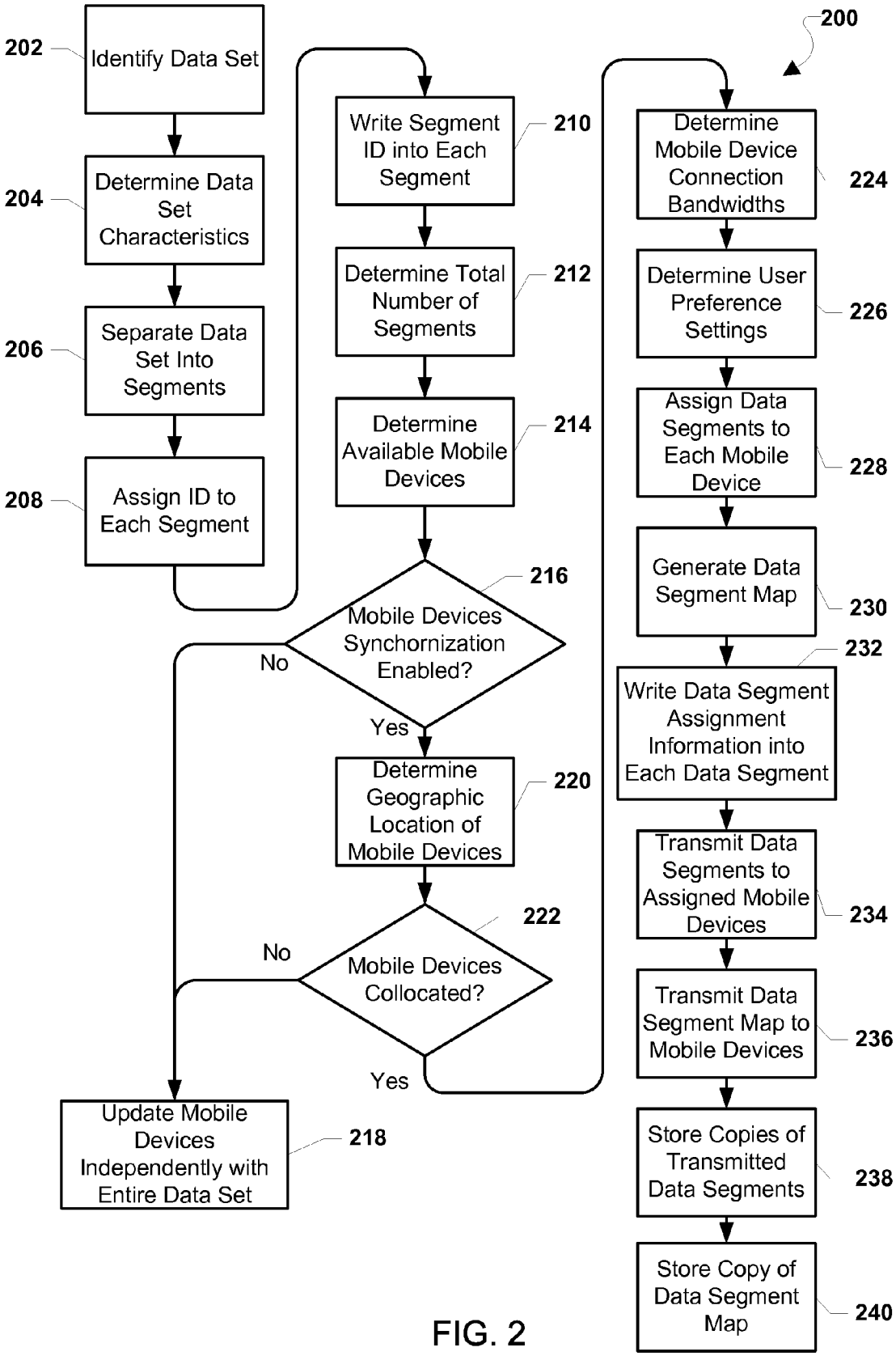
200
202
Identify Data Set
204
Determine Data Set Characteristics
206
Separate Data Set Into Segments
208
Assign ID to Each Segment
210
Write Segment ID into Each Segment
212
Determine Total Number of Segments
214
Determine Available Mobile Devices
216
Mobile Devices Synchornization Enabled?
No
Yes
220
Determine Geographic Location of Mobile Devices
222
Mobile Devices Collocated?
No
Yes
218
Update Mobile Devices Independently with Entire Data Set
224
Determine Mobile Device Connection Bandwidths
226
Determine User Preference Settings
228
Assign Data Segments to Each Mobile Device
230
Generate Data Segment Map
232
Write Data Segment Assignment Information into Each Data Segment
234
Transmit Data Segments to Assigned Mobile Devices
236
Transmit Data Segment Map to Mobile Devices
238
Store Copies of Transmitted Data Segments
240
Store Copy of Data Segment Map

FIG. 2

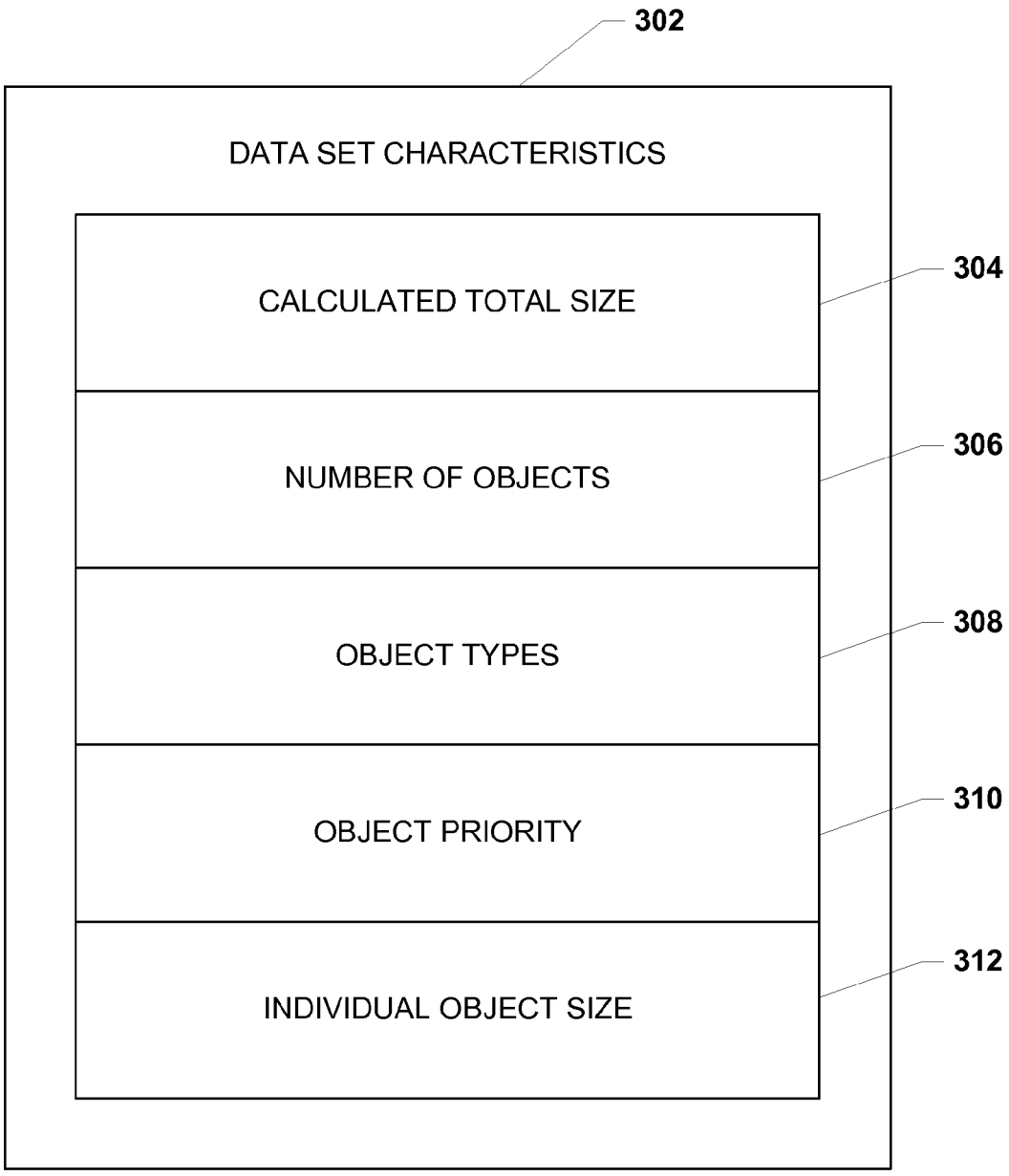
302
DATA SET CHARACTERISTICS
CALCULATED TOTAL SIZE
304
NUMBER OF OBJECTS
306
OBJECT TYPES
308
OBJECT PRIORITY
310
INDIVIDUAL OBJECT SIZE
312

FIG. 3

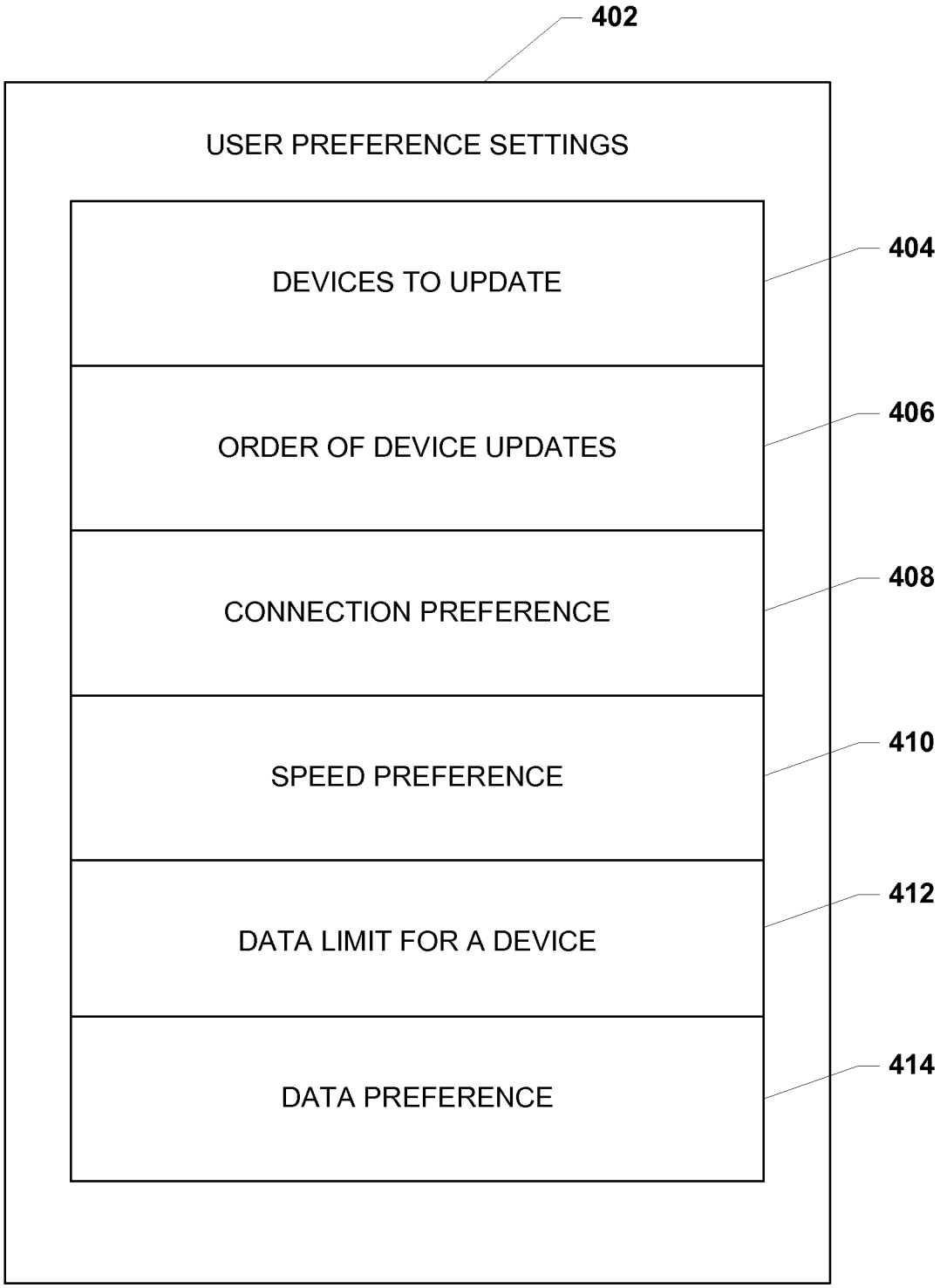
402
USER PREFERENCE SETTINGS
DEVICES TO UPDATE
404
ORDER OF DEVICE UPDATES
406
CONNECTION PREFERENCE
408
SPEED PREFERENCE
410
DATA LIMIT FOR A DEVICE
412
DATA PREFERENCE
414

FIG. 4

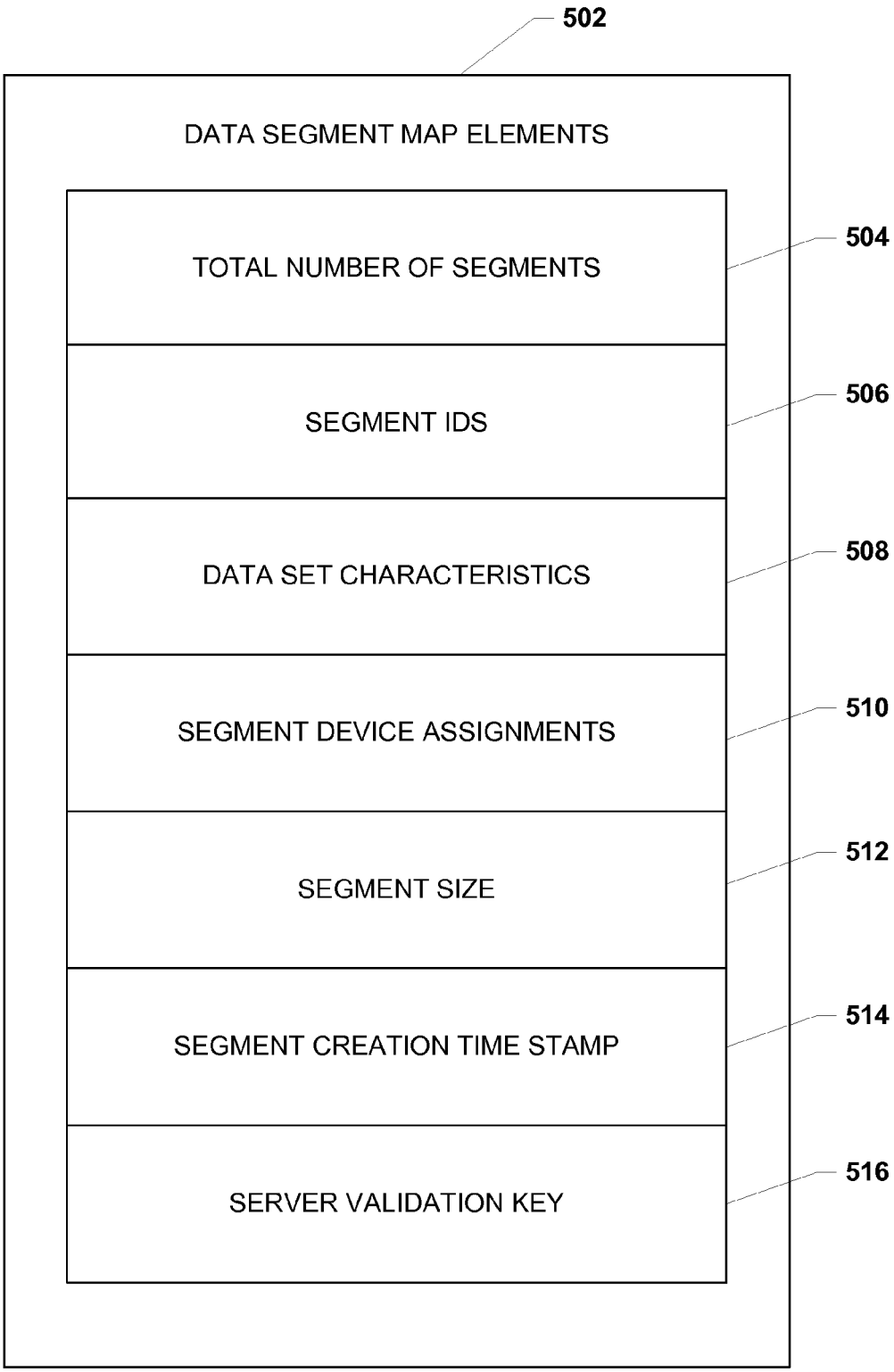
502
DATA SEGMENT MAP ELEMENTS
TOTAL NUMBER OF SEGMENTS
504
SEGMENT IDS
506
DATA SET CHARACTERISTICS
508
SEGMENT DEVICE ASSIGNMENTS
510
SEGMENT SIZE
512
SEGMENT CREATION TIME STAMP
514
SERVER VALIDATION KEY
516

FIG. 5

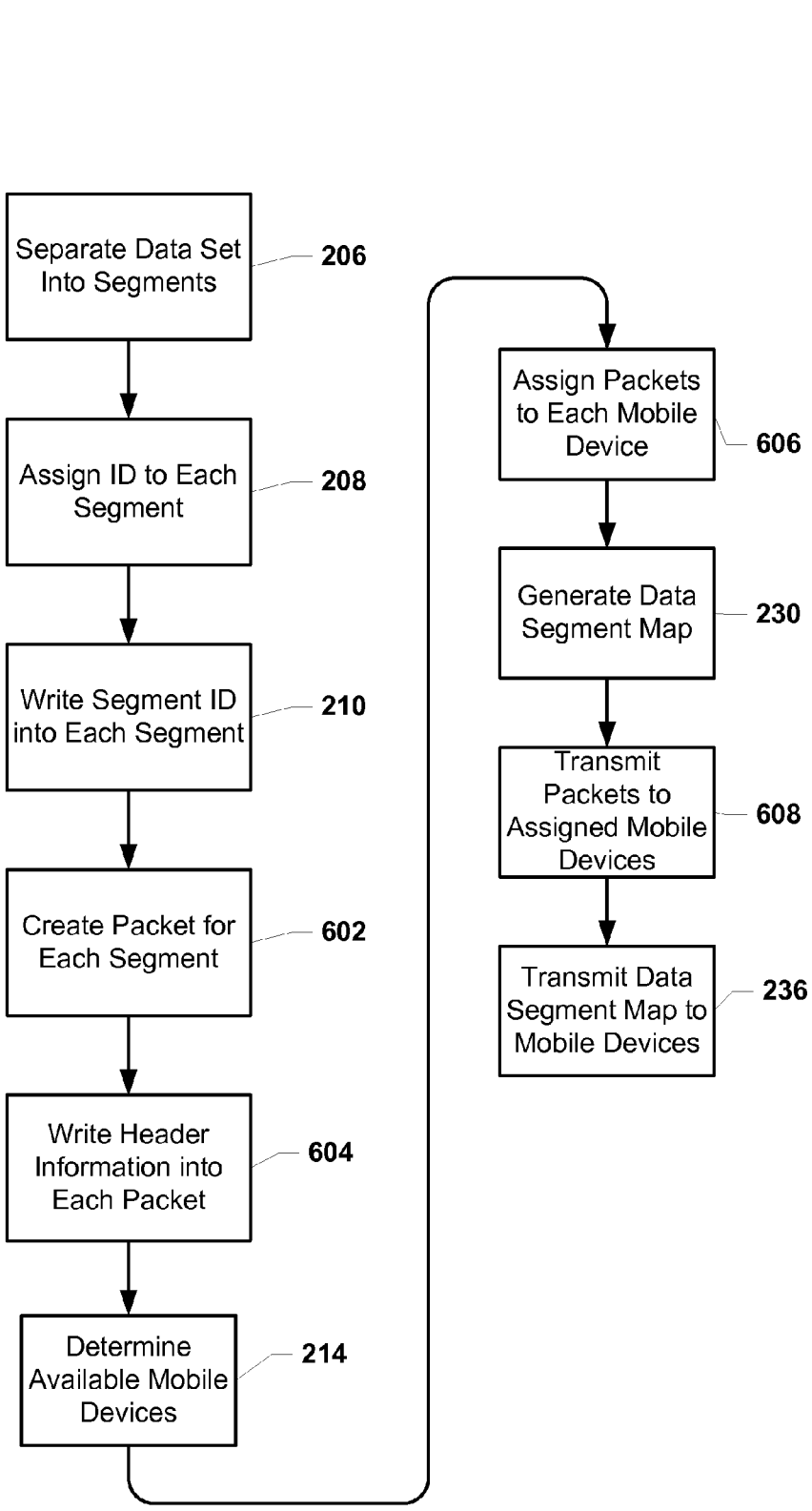
600
Separate Data Set Into Segments
206
Assign ID to Each Segment
208
Write Segment ID into Each Segment
210
Create Packet for Each Segment
602
Write Header Information into Each Packet
604
Determine Available Mobile Devices
214
Assign Packets to Each Mobile Device
606
Generate Data Segment Map
230
Transmit Packets to Assigned Mobile Devices
608
Transmit Data Segment Map to Mobile Devices
236

FIG. 6

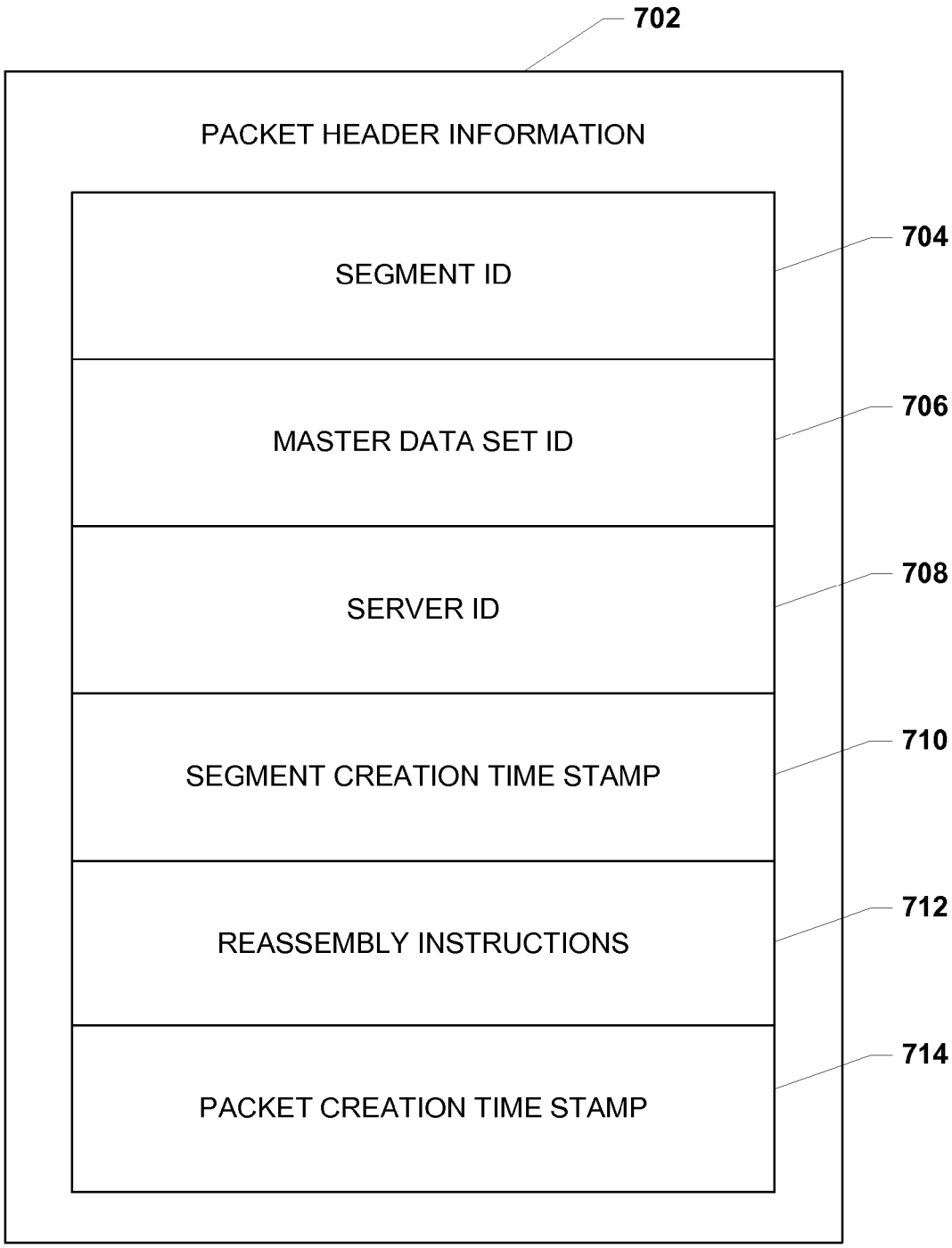
702
PACKET HEADER INFORMATION
SEGMENT ID
704
MASTER DATA SET ID
706
SERVER ID
708
SEGMENT CREATION TIME STAMP
710
REASSEMBLY INSTRUCTIONS
712
PACKET CREATION TIME STAMP
714

FIG. 7

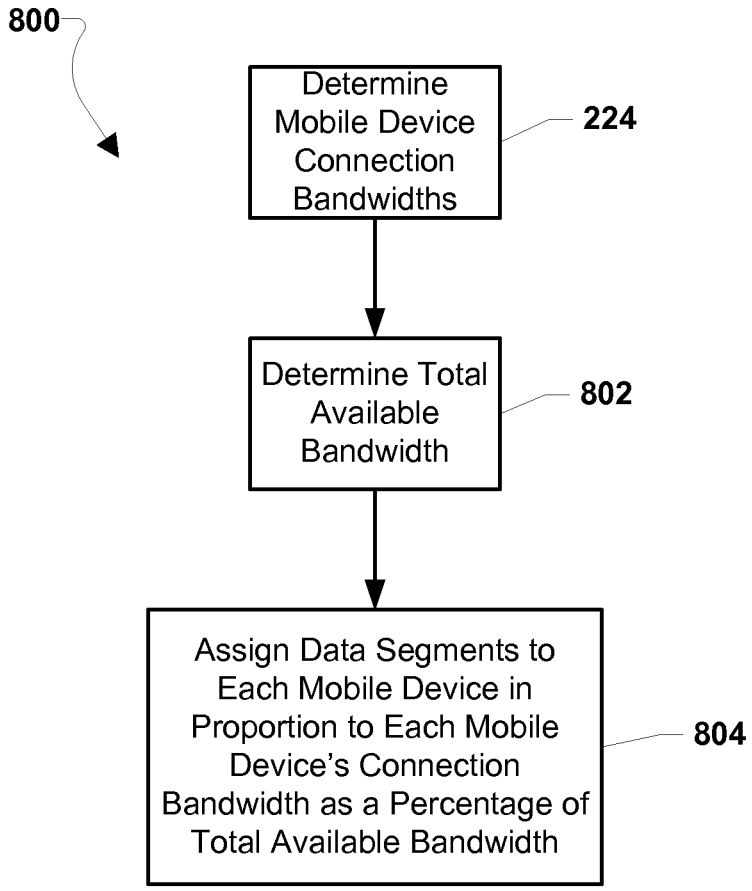
800
Determine Mobile Device Connection Bandwidths
224
Determine Total Available Bandwidth
802
Assign Data Segments to Each Mobile Device in Proportion to Each Mobile Device's Connection Bandwidth as a Percentage of Total Available Bandwidth
804

FIG. 8

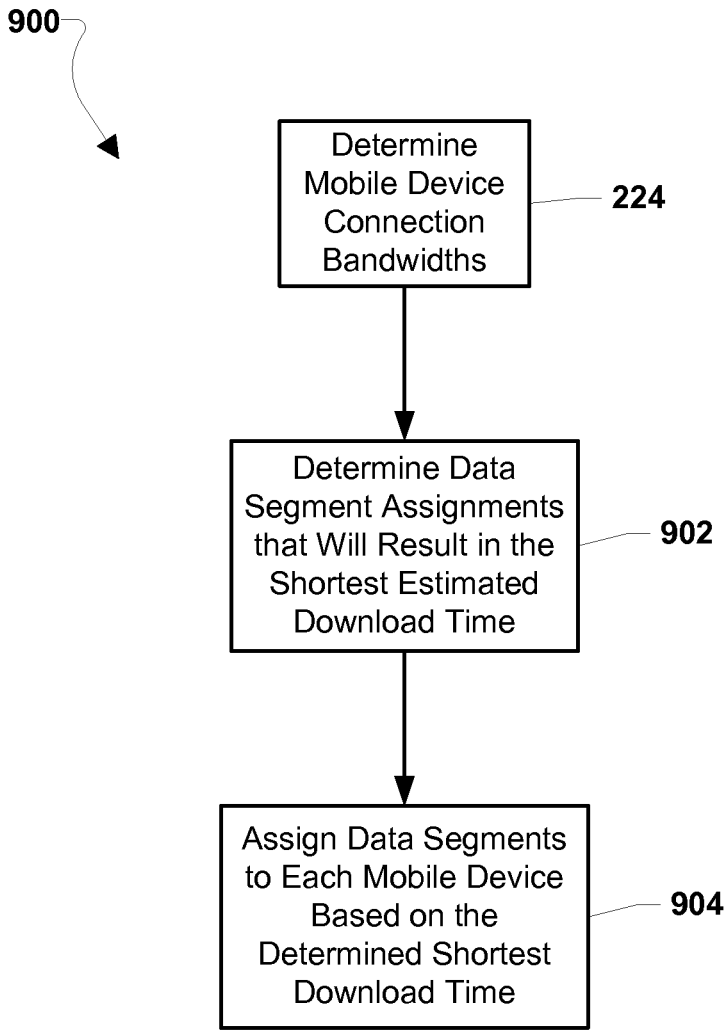
900
Determine Mobile Device Connection Bandwidths
224
Determine Data Segment Assignments that Will Result in the Shortest Estimated Download Time
902
Assign Data Segments to Each Mobile Device Based on the Determined Shortest Download Time
904

FIG. 9

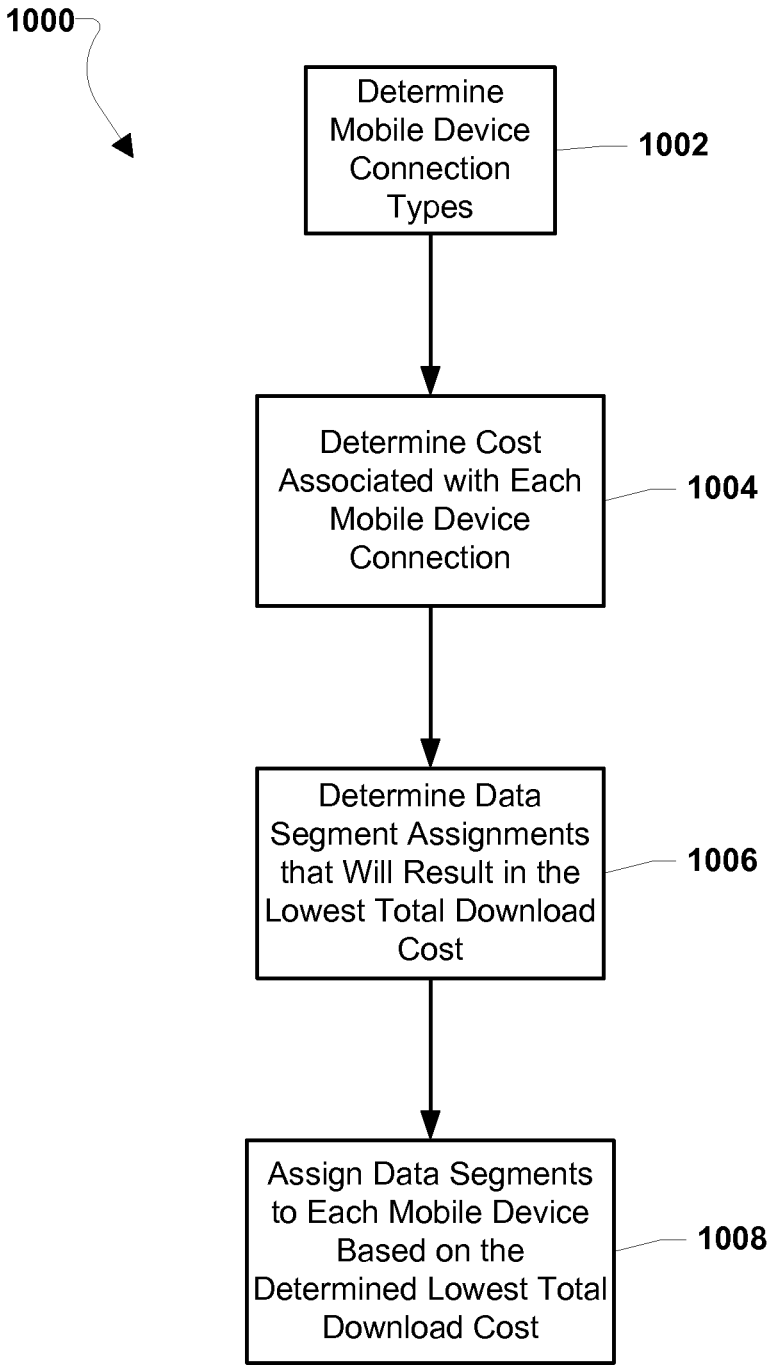
1000
Determine Mobile Device Connection Types
1002
Determine Cost Associated with Each Mobile Device Connection
1004
Determine Data Segment Assignments that Will Result in the Lowest Total Download Cost
1006
Assign Data Segments to Each Mobile Device Based on the Determined Lowest Total Download Cost
1008

FIG. 10

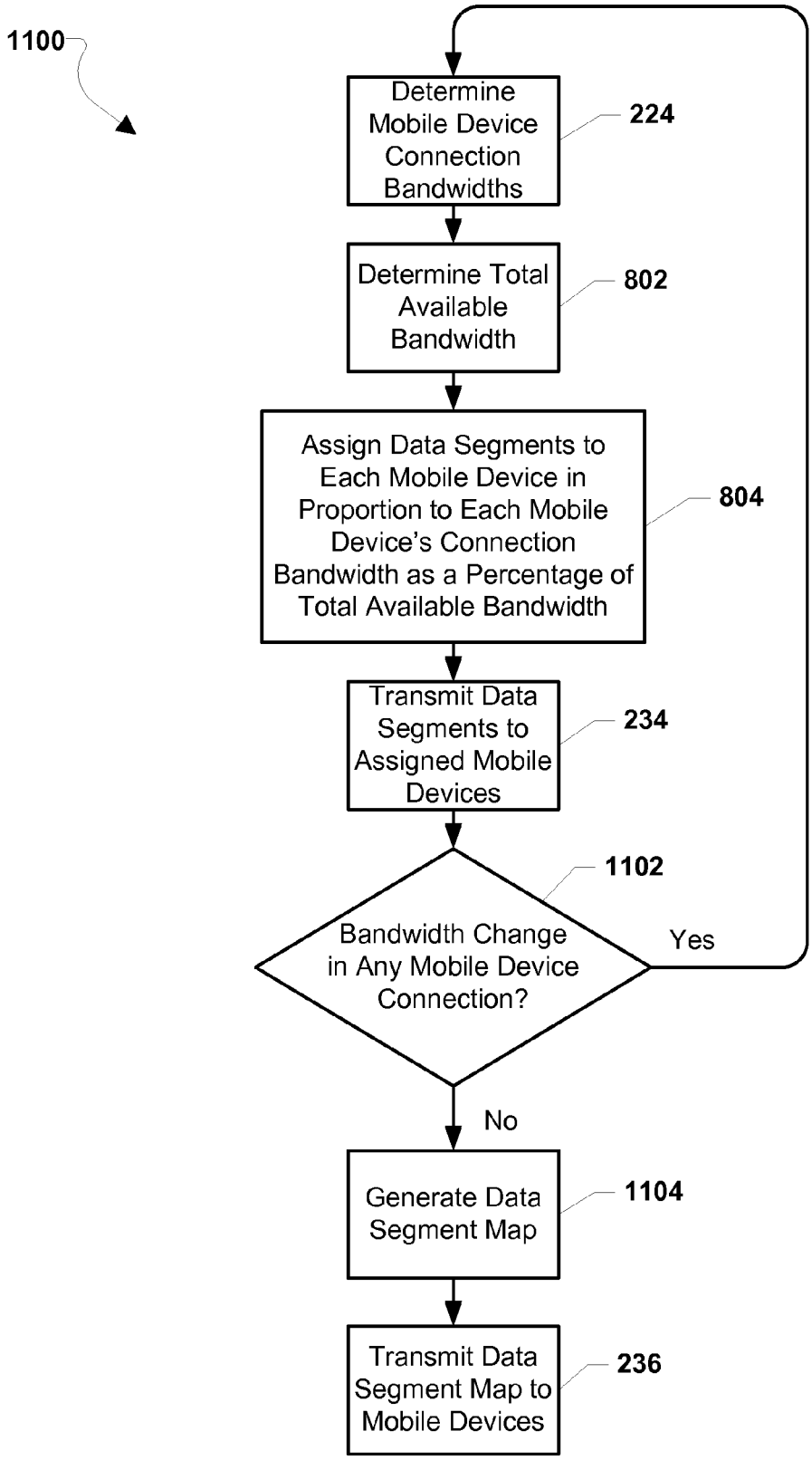
1100
Determine Mobile Device Connection Bandwidths
224
Determine Total Available Bandwidth
802
Assign Data Segments to Each Mobile Device in Proportion to Each Mobile Device's Connection Bandwidth as a Percentage of Total Available Bandwidth
804
Transmit Data Segments to Assigned Mobile Devices
234
1102
Bandwidth Change in Any Mobile Device Connection?
Yes
No
Generate Data Segment Map
1104
Transmit Data Segment Map to Mobile Devices
236

FIG. 11

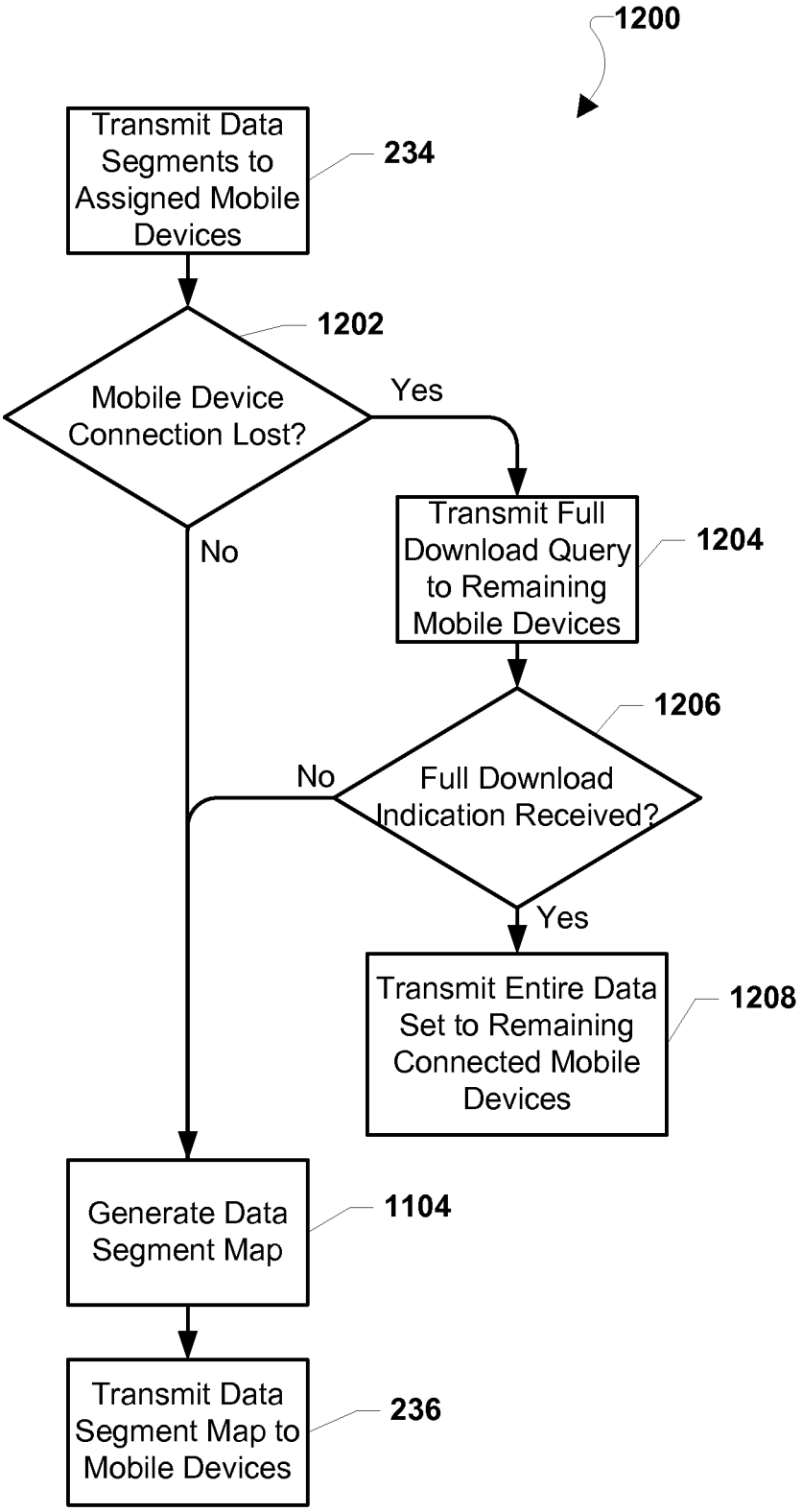
1200
Transmit Data Segments to Assigned Mobile Devices
234
1202
Mobile Device Connection Lost?
Yes
No
Transmit Full Download Query to Remaining Mobile Devices
1204
1206
Full Download Indication Received?
No
Yes
Transmit Entire Data Set to Remaining Connected Mobile Devices
1208
Generate Data Segment Map
1104
Transmit Data Segment Map to Mobile Devices
236

FIG. 12

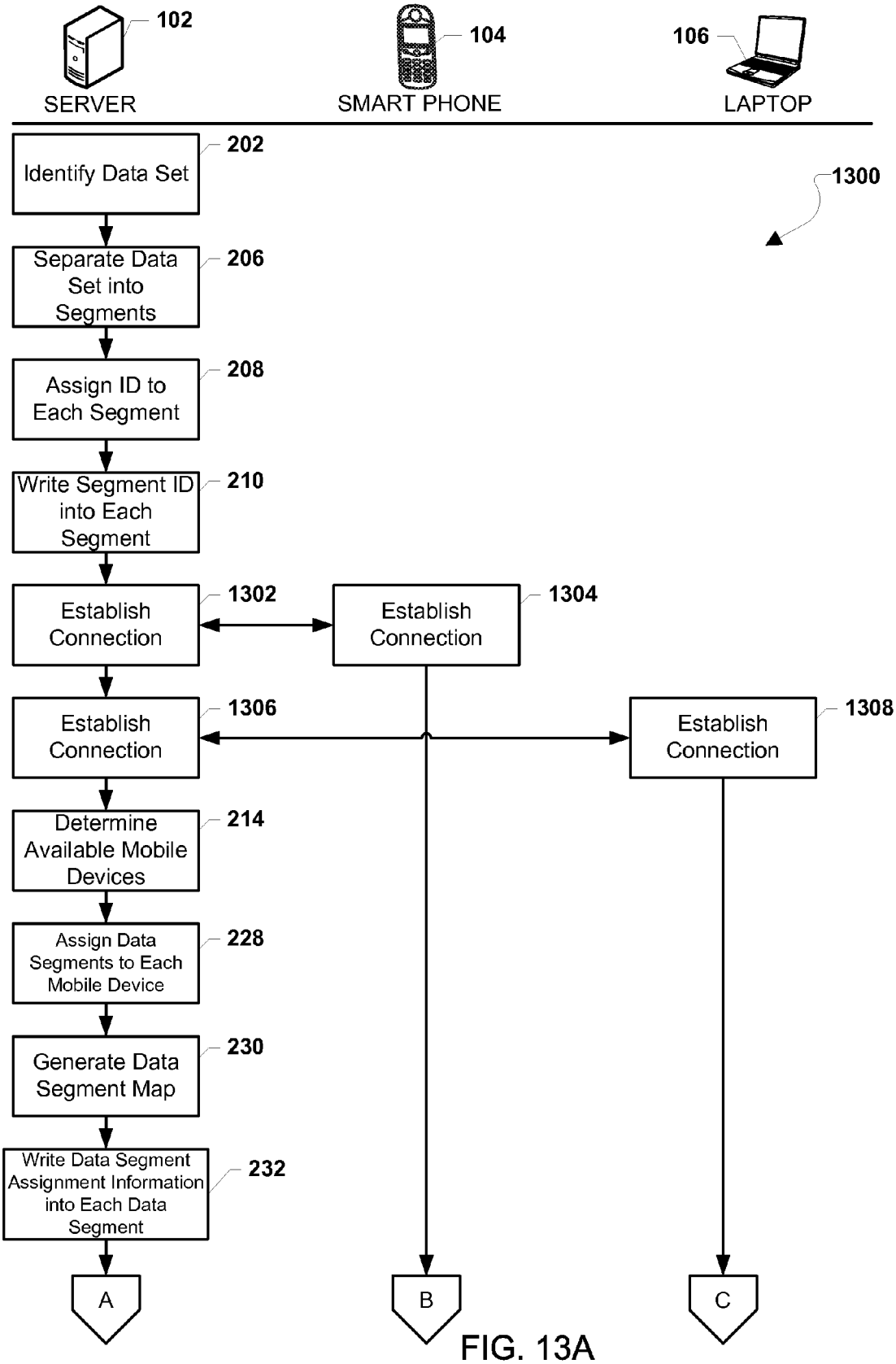
102
SERVER
104
SMART PHONE
106
LAPTOP
1300
Identify Data Set
202
Separate Data Set into Segments
206
Assign ID to Each Segment
208
Write Segment ID into Each Segment
210
Establish Connection
1302
Establish Connection
1304
Establish Connection
1306
Establish Connection
1308
Determine Available Mobile Devices
214
Assign Data Segments to Each Mobile Device
228
Generate Data Segment Map
230
Write Data Segment Assignment Information into Each Data Segment
232
A
B
C

FIG. 13A

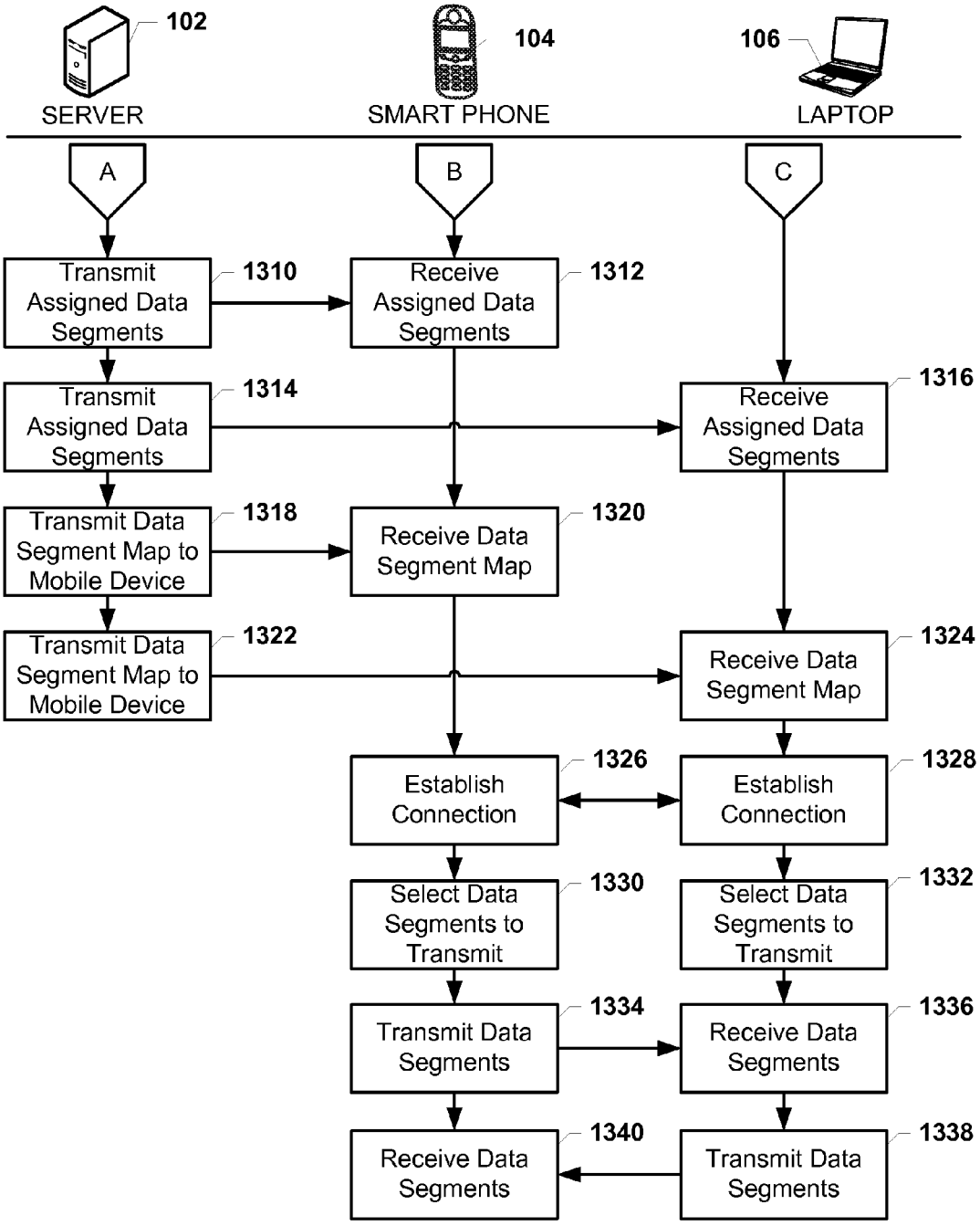
102
SERVER
104
SMART PHONE
106
LAPTOP
A
B
C
Transmit Assigned Data Segments
1310
Receive Assigned Data Segments
1312
Transmit Assigned Data Segments
1314
Receive Assigned Data Segments
1316
Transmit Data Segment Map to Mobile Device
1318
Receive Data Segment Map
1320
Transmit Data Segment Map to Mobile Device
1322
Receive Data Segment Map
1324
Establish Connection
1326
Establish Connection
1328
Select Data Segments to Transmit
1330
Select Data Segments to Transmit
1332
Transmit Data Segments
1334
Receive Data Segments
1336
Receive Data Segments
1340
Transmit Data Segments
1338

FIG. 13B

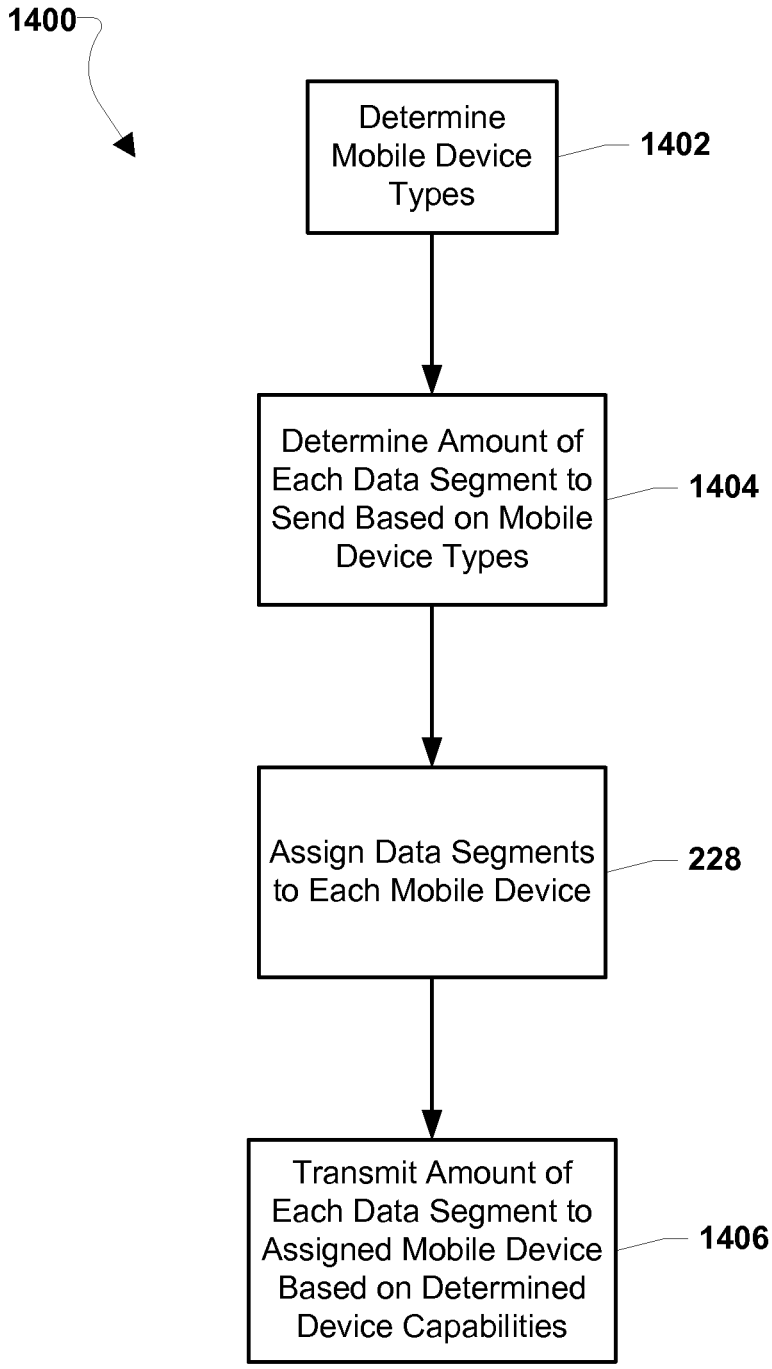
1400
Determine Mobile Device Types
1402
Determine Amount of Each Data Segment to Send Based on Mobile Device Types
1404
Assign Data Segments to Each Mobile Device
228
Transmit Amount of Each Data Segment to Assigned Mobile Device Based on Determined Device Capabilities
1406

FIG. 14

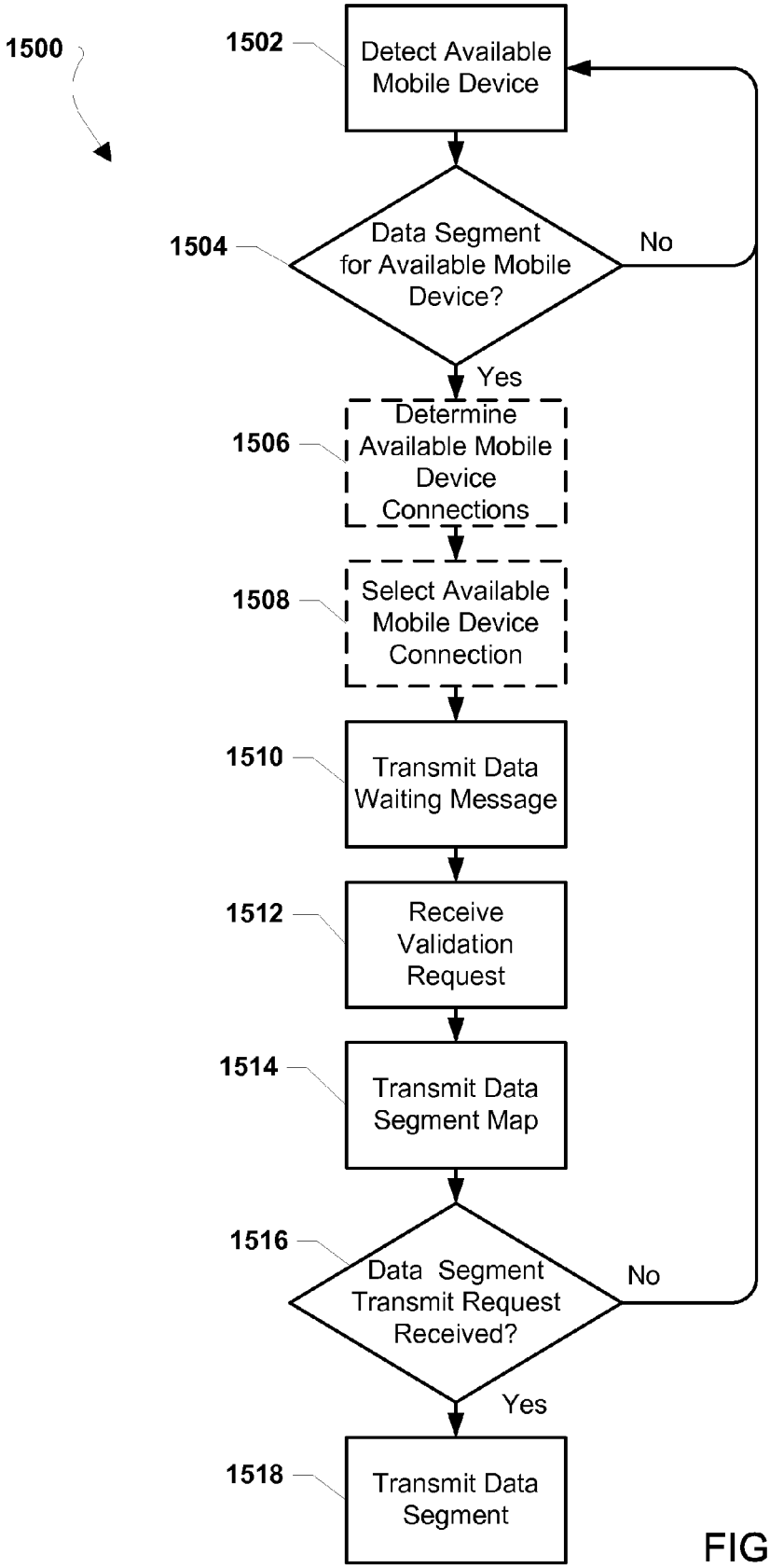
1500
1502
Detect Available Mobile Device
1504
Data Segment for Available Mobile Device?
No
Yes
1506
Determine Available Mobile Device Connections
1508
Select Available Mobile Device Connection
1510
Transmit Data Waiting Message
1512
Receive Validation Request
1514
Transmit Data Segment Map
1516
Data Segment Transmit Request Received?
No
Yes
1518
Transmit Data Segment

FIG. 15

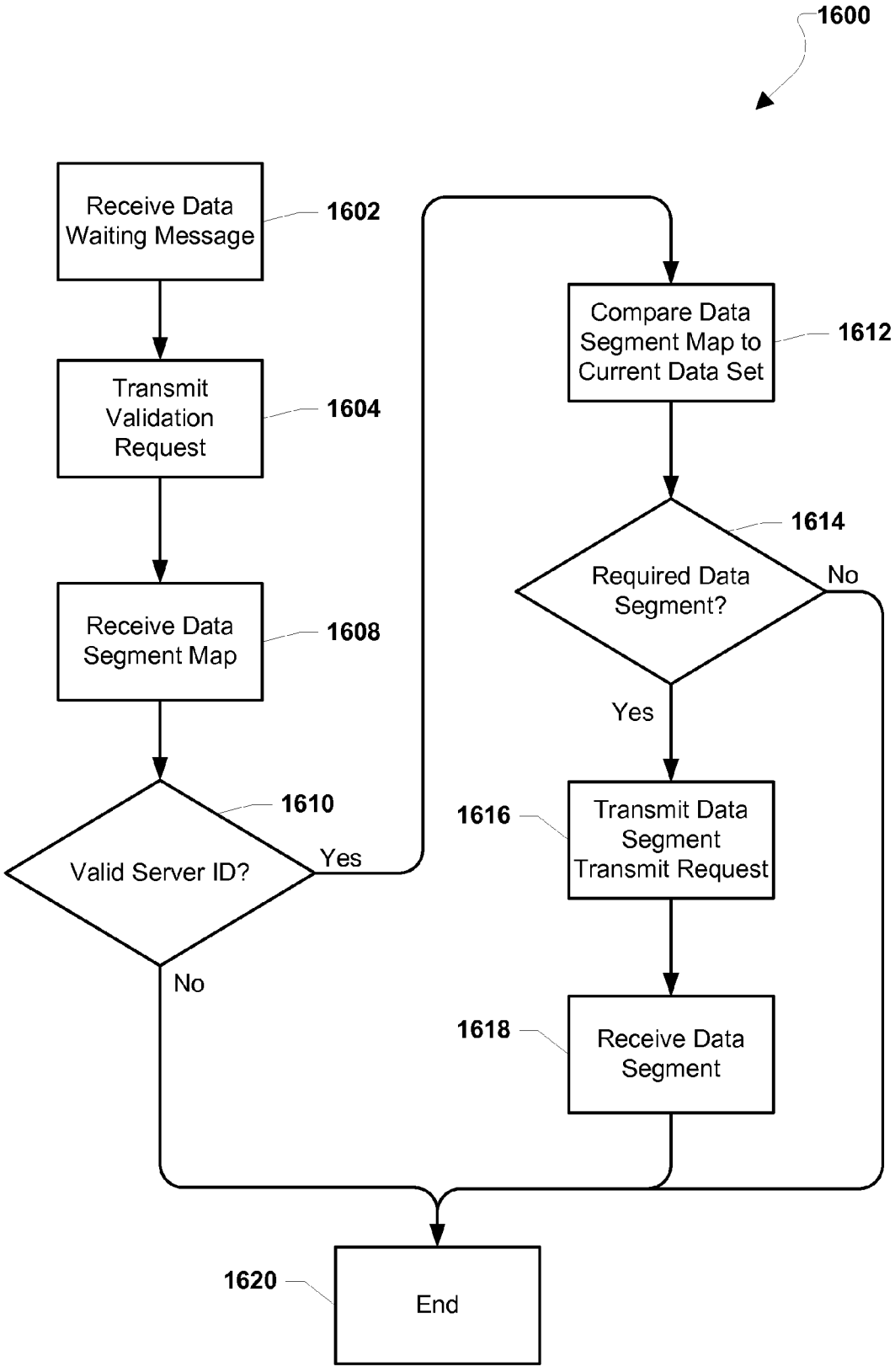
1600
Receive Data Waiting Message
1602
Transmit Validation Request
1604
Receive Data Segment Map
1608
Valid Server ID?
1610
Yes
No
Compare Data Segment Map to Current Data Set
1612
Required Data Segment?
1614
No
Yes
Transmit Data Segment Transmit Request
1616
Receive Data Segment
1618
End
1620

FIG. 16

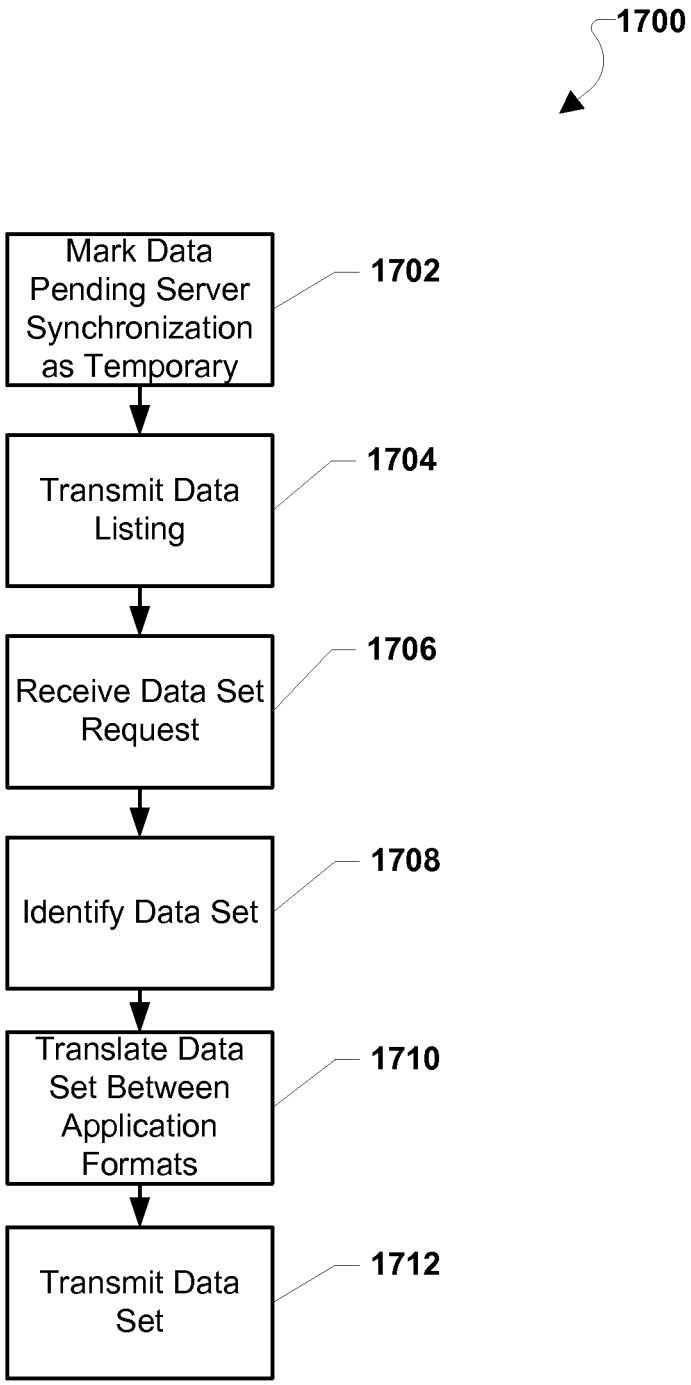
1700
Mark Data Pending Server Synchronization as Temporary
1702
Transmit Data Listing
1704
Receive Data Set Request
1706
Identify Data Set
1708
Translate Data Set Between Application Formats
1710
Transmit Data Set
1712

FIG. 17

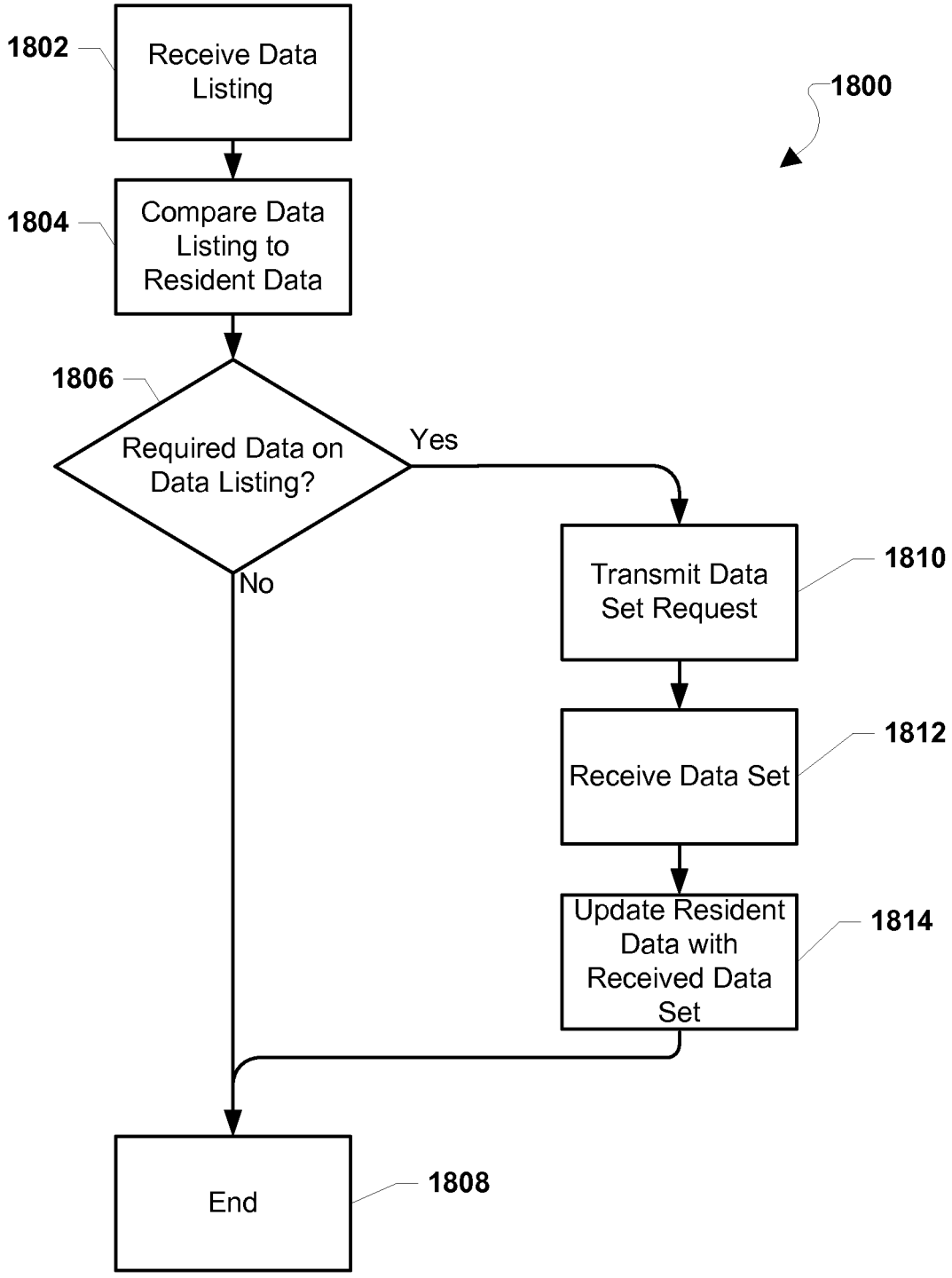
1802
Receive Data Listing
1800
1804
Compare Data Listing to Resident Data
1806
Required Data on Data Listing?
Yes
No
Transmit Data Set Request
1810
Receive Data Set
1812
Update Resident Data with Received Data Set
1814
End
1808

FIG. 18

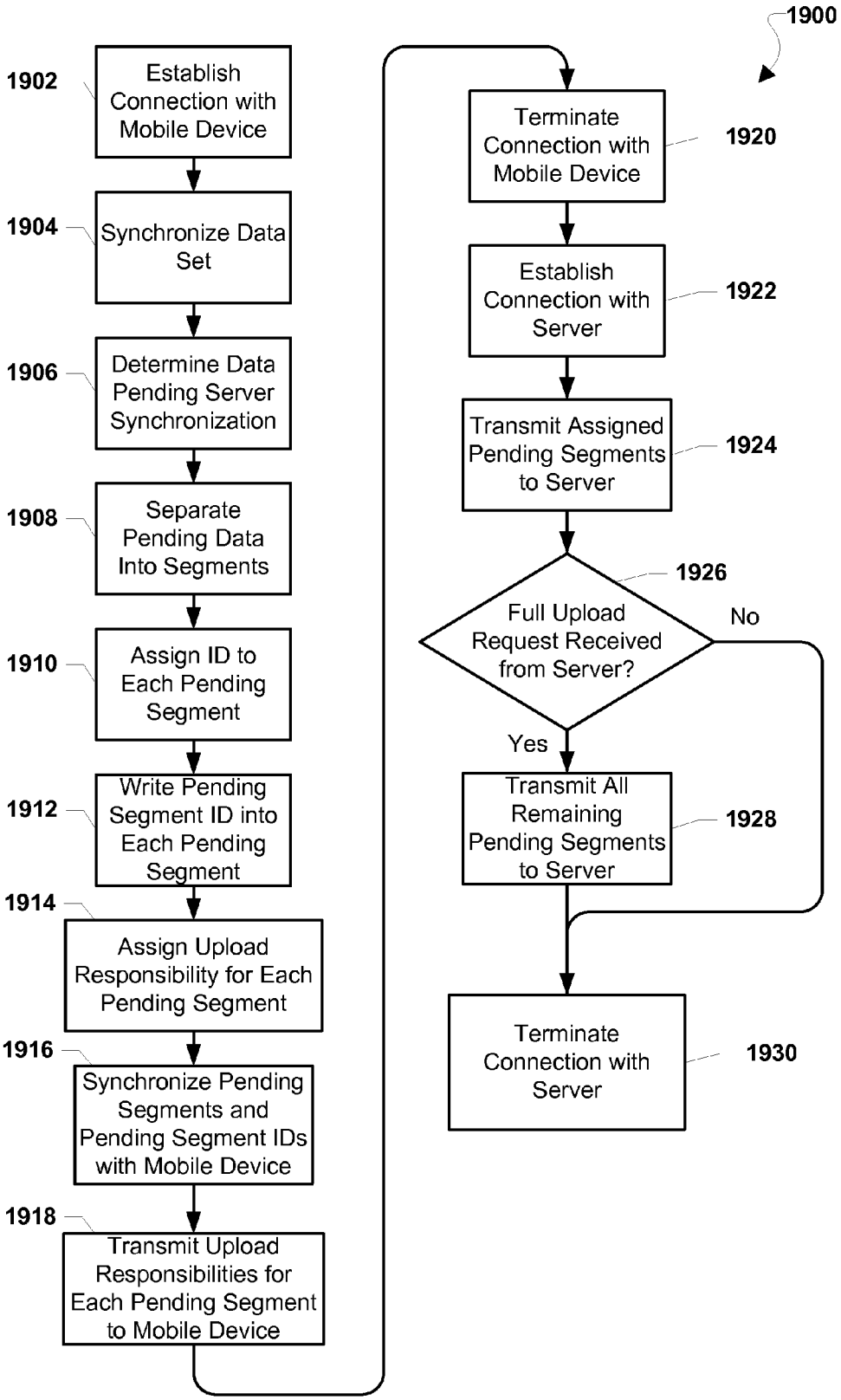
1900
1902
Establish Connection with Mobile Device
1904
Synchronize Data Set
1906
Determine Data Pending Server Synchronization
1908
Separate Pending Data Into Segments
1910
Assign ID to Each Pending Segment
1912
Write Pending Segment ID into Each Pending Segment
1914
Assign Upload Responsibility for Each Pending Segment
1916
Synchronize Pending Segments and Pending Segment IDs with Mobile Device
1918
Transmit Upload Responsibilities for Each Pending Segment to Mobile Device
1920
Terminate Connection with Mobile Device
1922
Establish Connection with Server
1924
Transmit Assigned Pending Segments to Server
1926
Full Upload Request Received from Server?
No
Yes
1928
Transmit All Remaining Pending Segments to Server
1930
Terminate Connection with Server

FIG. 19

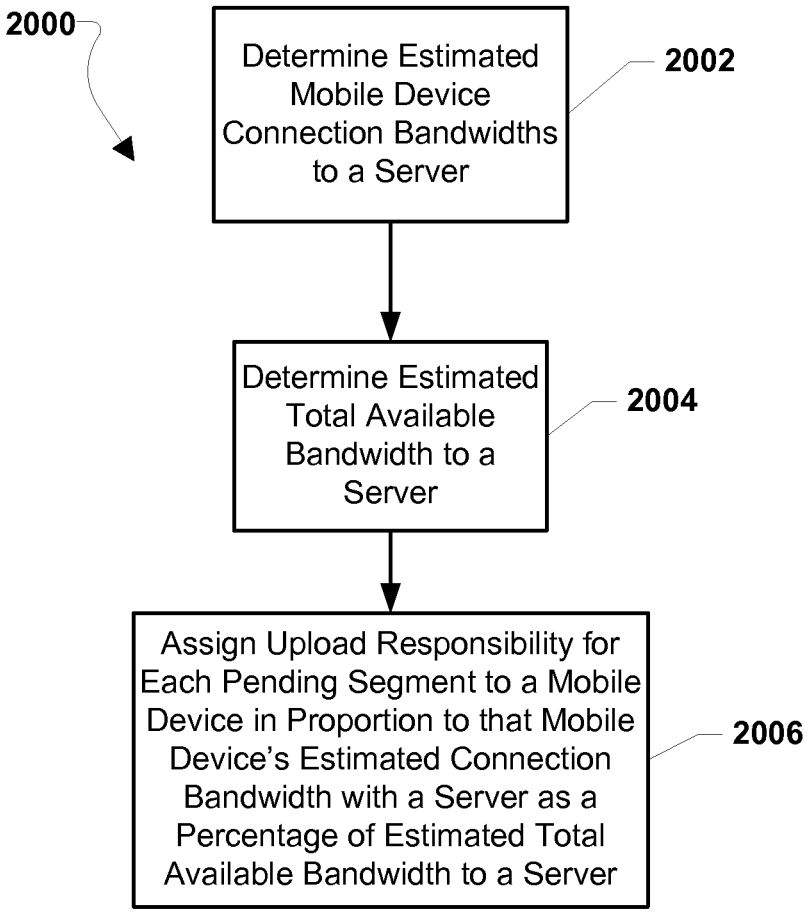
2000
Determine Estimated Mobile Device Connection Bandwidths to a Server
2002
Determine Estimated Total Available Bandwidth to a Server
2004
Assign Upload Responsibility for Each Pending Segment to a Mobile Device in Proportion to that Mobile Device's Estimated Connection Bandwidth with a Server as a Percentage of Estimated Total Available Bandwidth to a Server
2006

FIG. 20

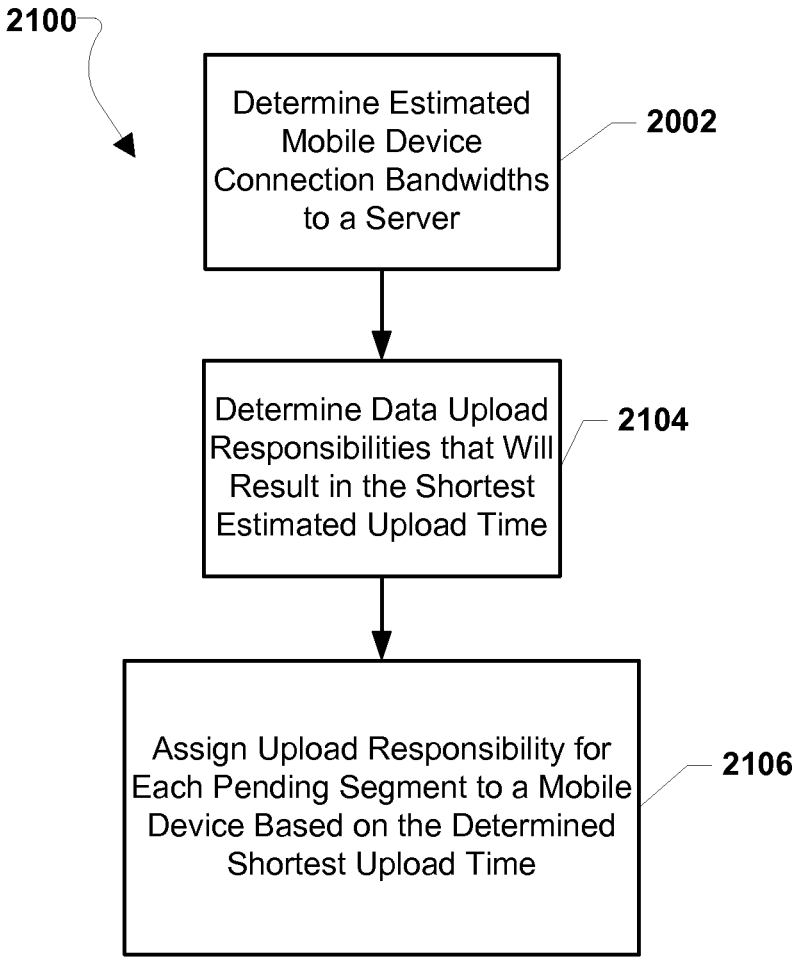
2100
Determine Estimated Mobile Device Connection Bandwidths to a Server
2002
Determine Data Upload Responsibilities that Will Result in the Shortest Estimated Upload Time
2104
Assign Upload Responsibility for Each Pending Segment to a Mobile Device Based on the Determined Shortest Upload Time
2106

FIG. 21

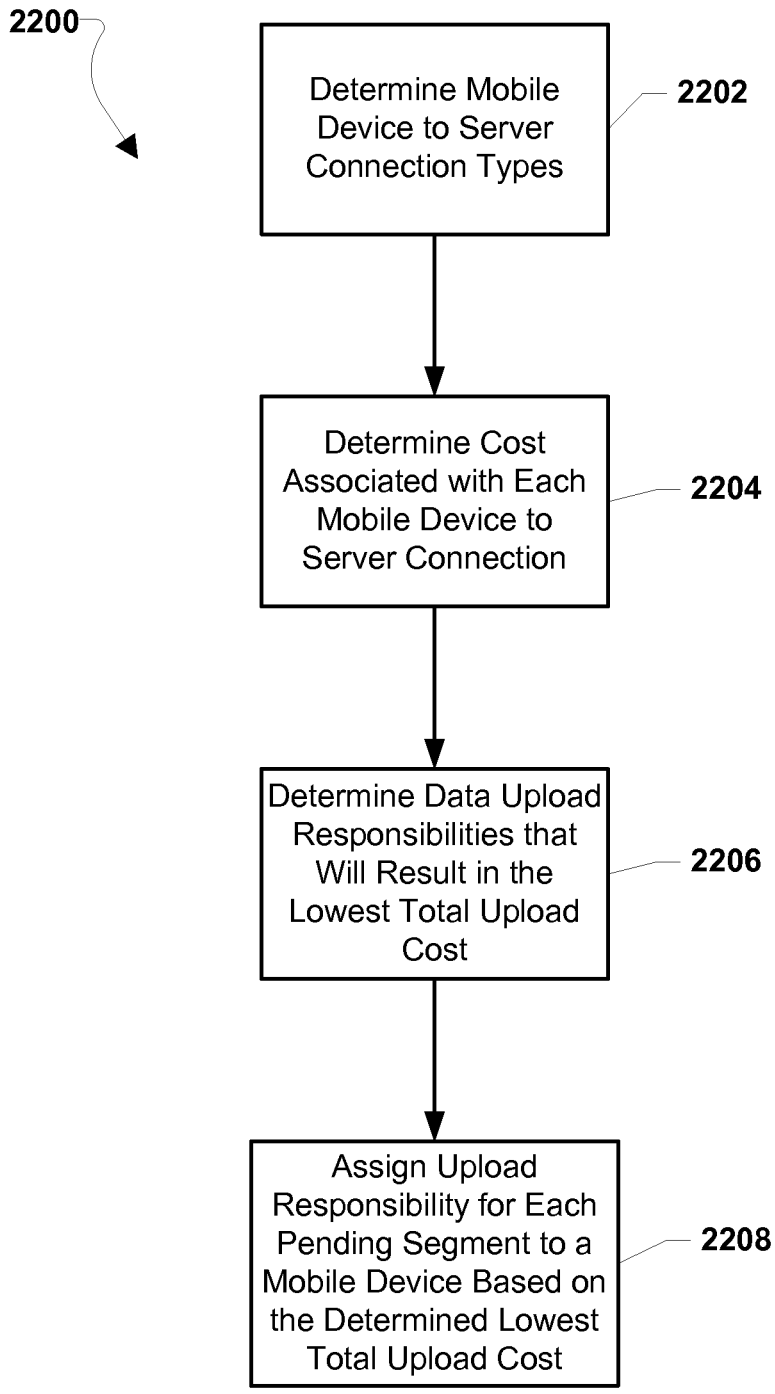
2200
Determine Mobile Device to Server Connection Types
2202
Determine Cost Associated with Each Mobile Device to Server Connection
2204
Determine Data Upload Responsibilities that Will Result in the Lowest Total Upload Cost
2206
Assign Upload Responsibility for Each Pending Segment to a Mobile Device Based on the Determined Lowest Total Upload Cost
2208

FIG. 22

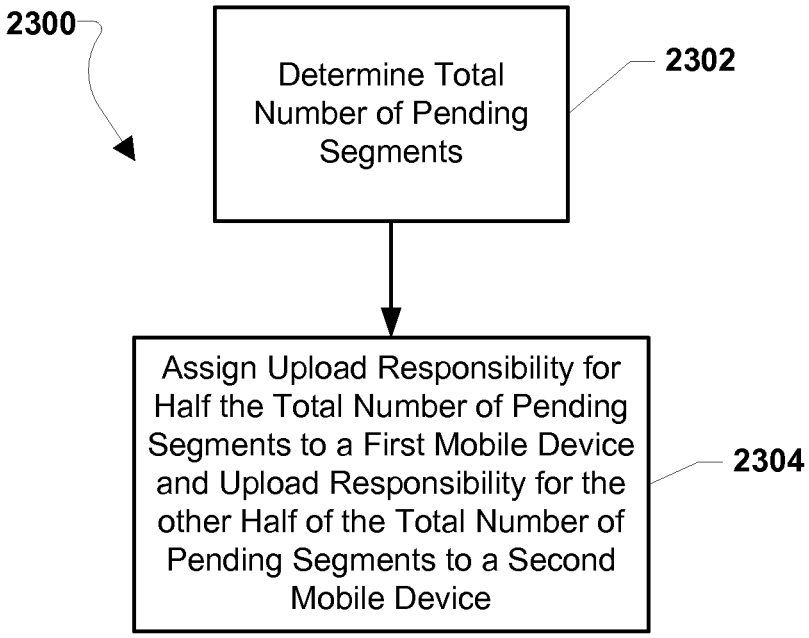
2300
Determine Total Number of Pending Segments
2302
Assign Upload Responsibility for Half the Total Number of Pending Segments to a First Mobile Device and Upload Responsibility for the other Half of the Total Number of Pending Segments to a Second Mobile Device
2304

FIG. 23

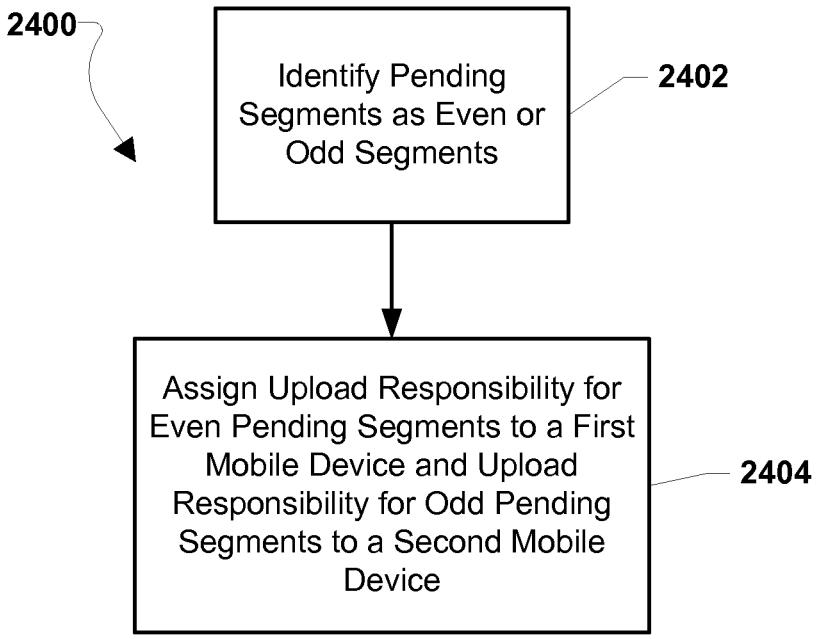
2400
Identify Pending Segments as Even or Odd Segments
2402
Assign Upload Responsibility for Even Pending Segments to a First Mobile Device and Upload Responsibility for Odd Pending Segments to a Second Mobile Device
2404

FIG. 24

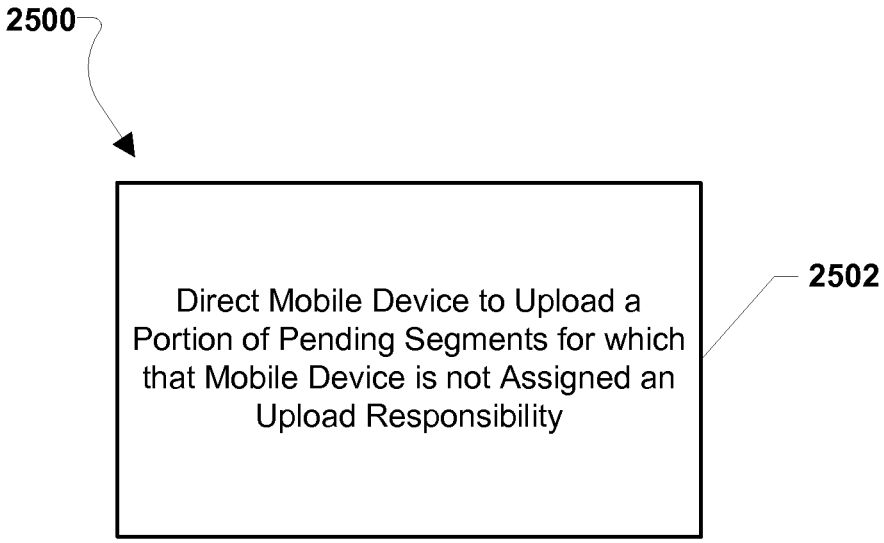
2500
Direct Mobile Device to Upload a Portion of Pending Segments for which that Mobile Device is not Assigned an Upload Responsibility
2502

FIG. 25

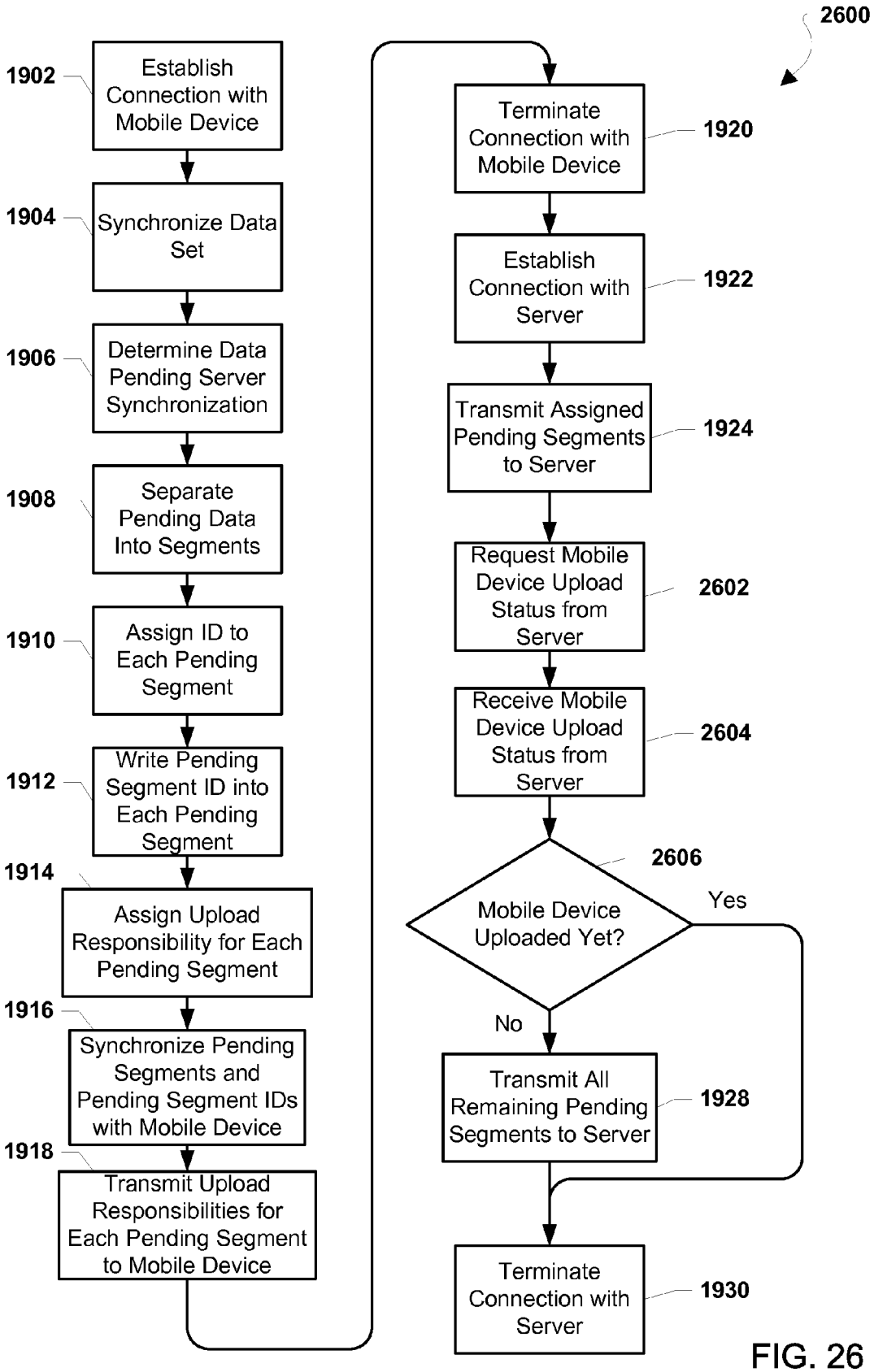
2600
1902
Establish Connection with Mobile Device
1904
Synchronize Data Set
1906
Determine Data Pending Server Synchronization
1908
Separate Pending Data Into Segments
1910
Assign ID to Each Pending Segment
1912
Write Pending Segment ID into Each Pending Segment
1914
Assign Upload Responsibility for Each Pending Segment
1916
Synchronize Pending Segments and Pending Segment IDs with Mobile Device
1918
Transmit Upload Responsibilities for Each Pending Segment to Mobile Device
Terminate Connection with Mobile Device
1920
Establish Connection with Server
1922
Transmit Assigned Pending Segments to Server
1924
Request Mobile Device Upload Status from Server
2602
Receive Mobile Device Upload Status from Server
2604
2606
Mobile Device Uploaded Yet?
Yes
No
Transmit All Remaining Pending Segments to Server
1928
Terminate Connection with Server
1930

FIG. 26

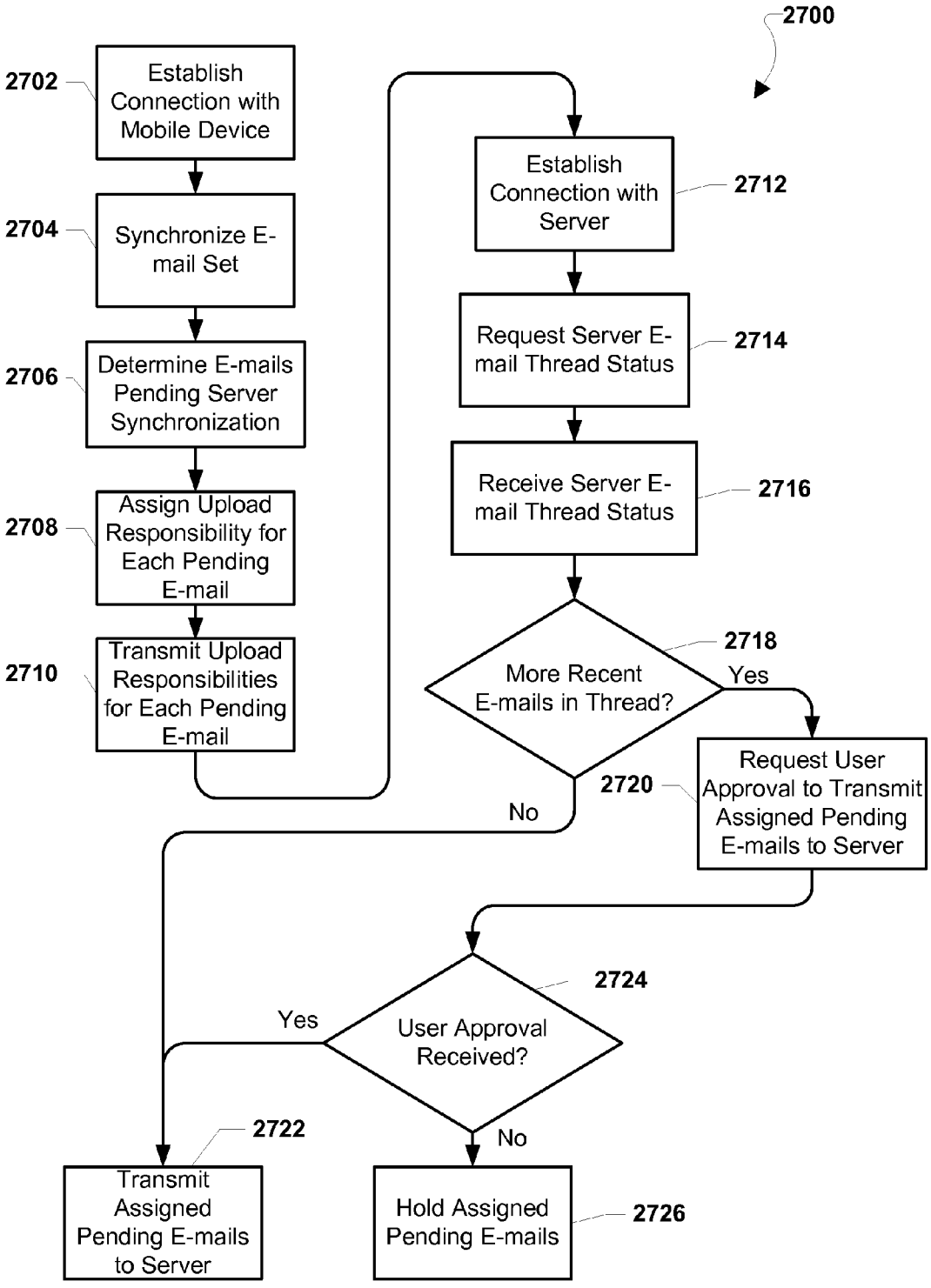
2700
2702
Establish Connection with Mobile Device
2704
Synchronize E-mail Set
2706
Determine E-mails Pending Server Synchronization
2708
Assign Upload Responsibility for Each Pending E-mail
2710
Transmit Upload Responsibilities for Each Pending E-mail
2712
Establish Connection with Server
2714
Request Server E-mail Thread Status
2716
Receive Server E-mail Thread Status
2718
More Recent E-mails in Thread?
Yes
No
2720
Request User Approval to Transmit Assigned Pending E-mails to Server
2724
User Approval Received?
Yes
No
2722
Transmit Assigned Pending E-mails to Server
2726
Hold Assigned Pending E-mails

FIG. 27

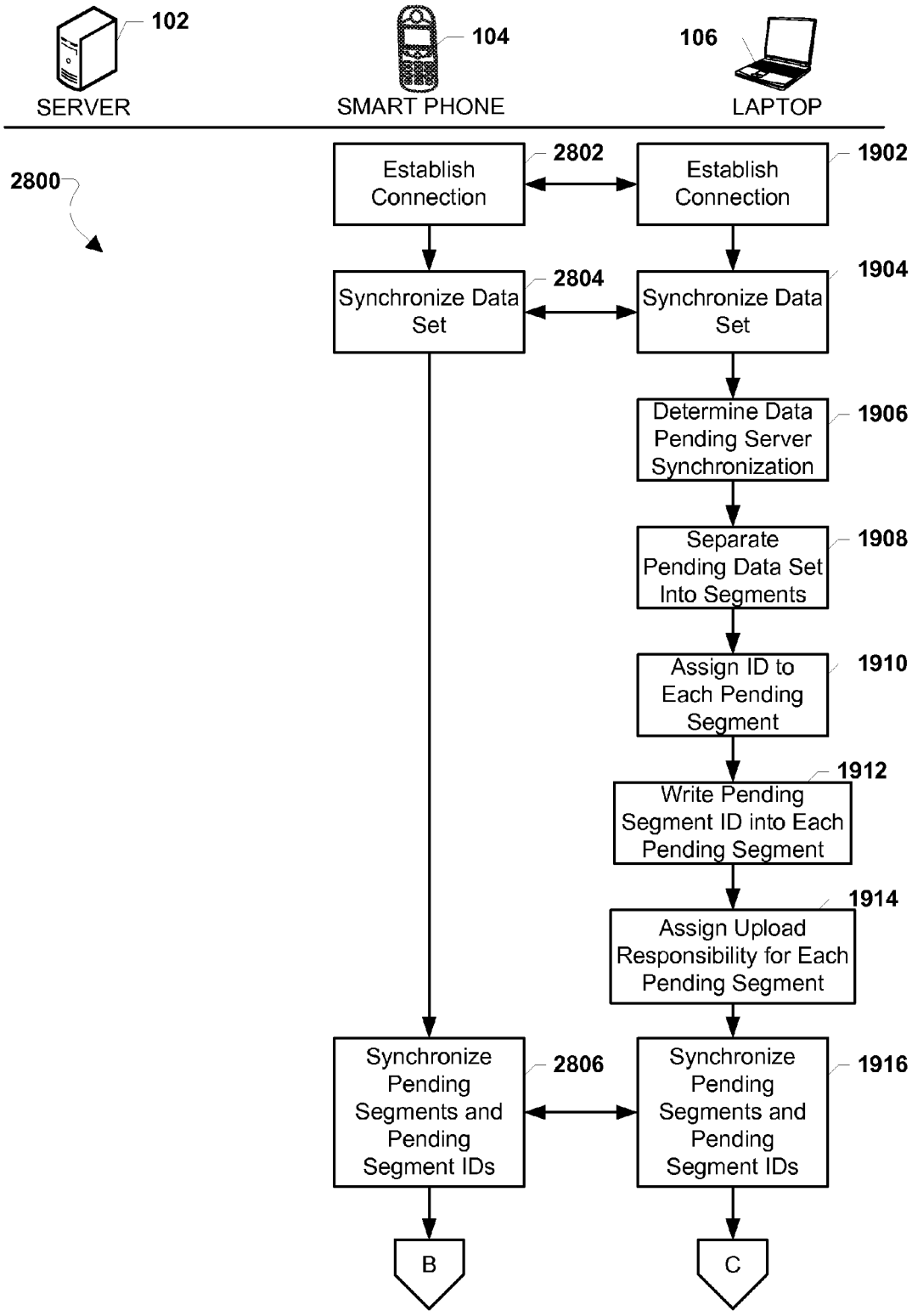
102
SERVER
104
SMART PHONE
106
LAPTOP
2800
Establish Connection
2802
Establish Connection
1902
Synchronize Data Set
2804
Synchronize Data Set
1904
Determine Data Pending Server Synchronization
1906
Separate Pending Data Set Into Segments
1908
Assign ID to Each Pending Segment
1910
Write Pending Segment ID into Each Pending Segment
1912
Assign Upload Responsibility for Each Pending Segment
1914
Synchronize Pending Segments and Pending Segment IDs
2806
Synchronize Pending Segments and Pending Segment IDs
1916
B
C

FIG. 28A

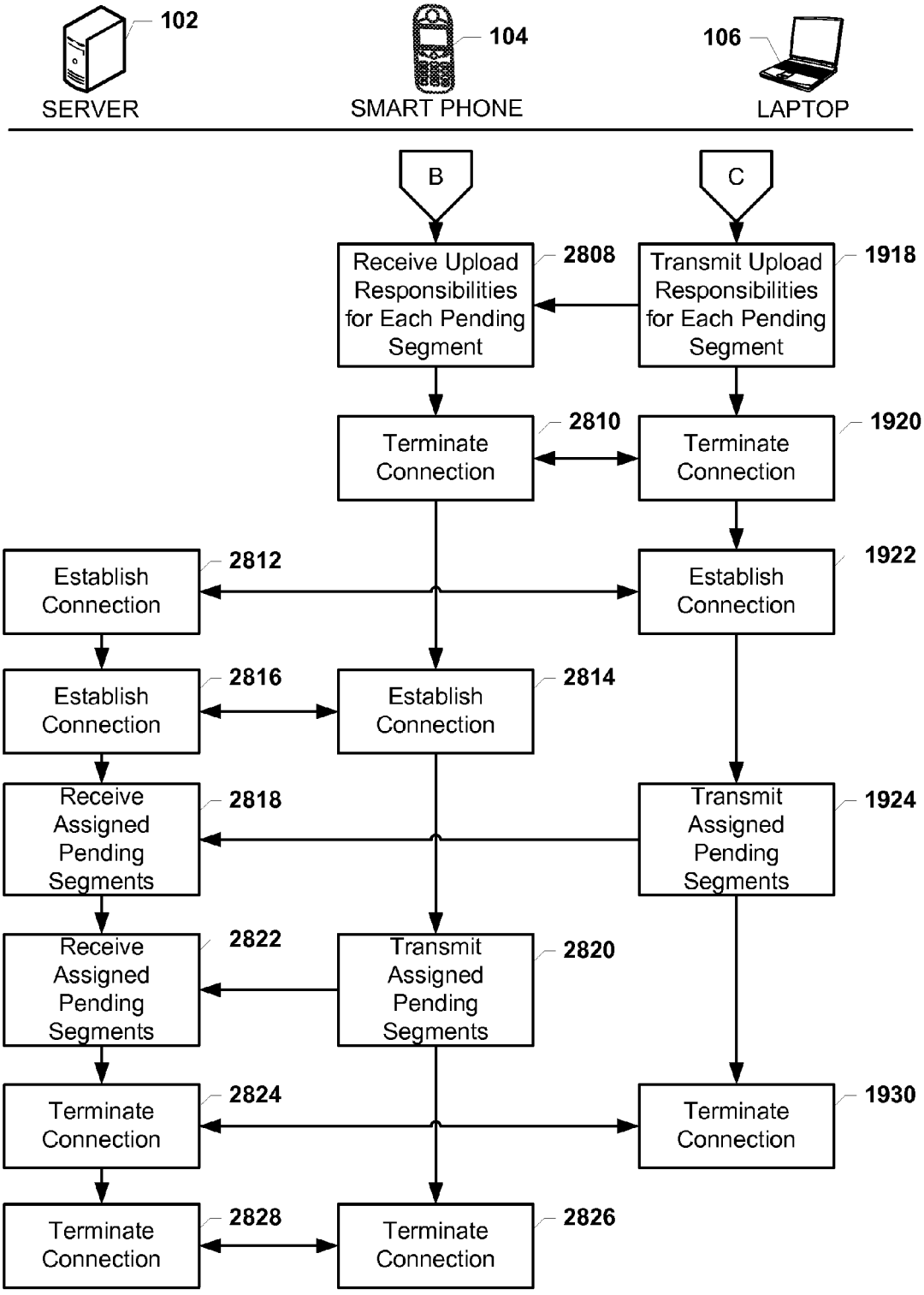
102
SERVER
104
SMART PHONE
106
LAPTOP
B
C
Receive Upload Responsibilities for Each Pending Segment
2808
Transmit Upload Responsibilities for Each Pending Segment
1918
Terminate Connection
2810
Terminate Connection
1920
Establish Connection
2812
Establish Connection
1922
Establish Connection
2816
Establish Connection
2814
Receive Assigned Pending Segments
2818
Transmit Assigned Pending Segments
1924
Receive Assigned Pending Segments
2822
Transmit Assigned Pending Segments
2820
Terminate Connection
2824
Terminate Connection
1930
Terminate Connection
2828
Terminate Connection
2826

FIG. 28B

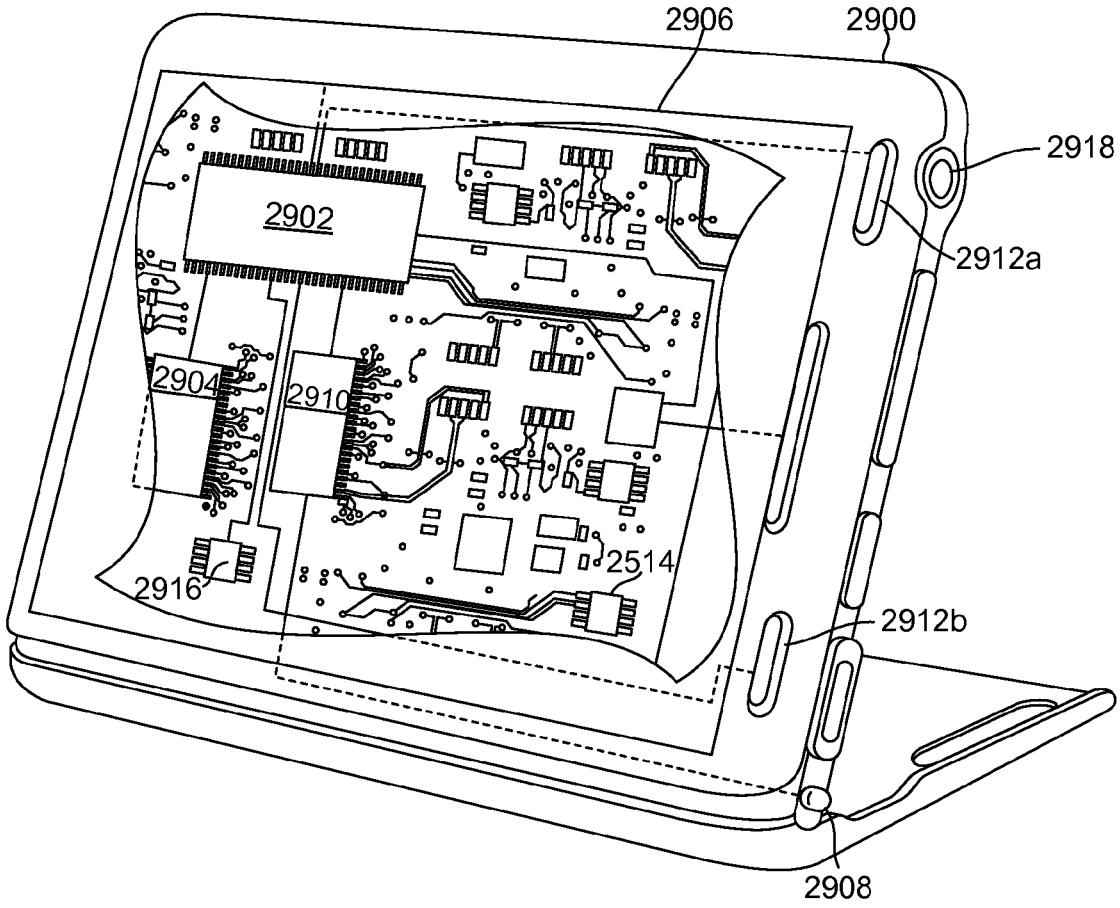

FIG. 29

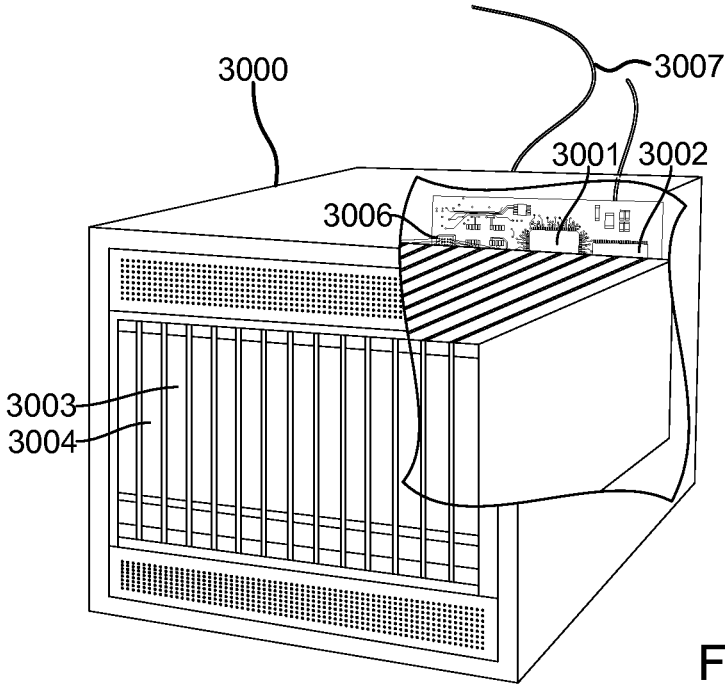

FIG. 30

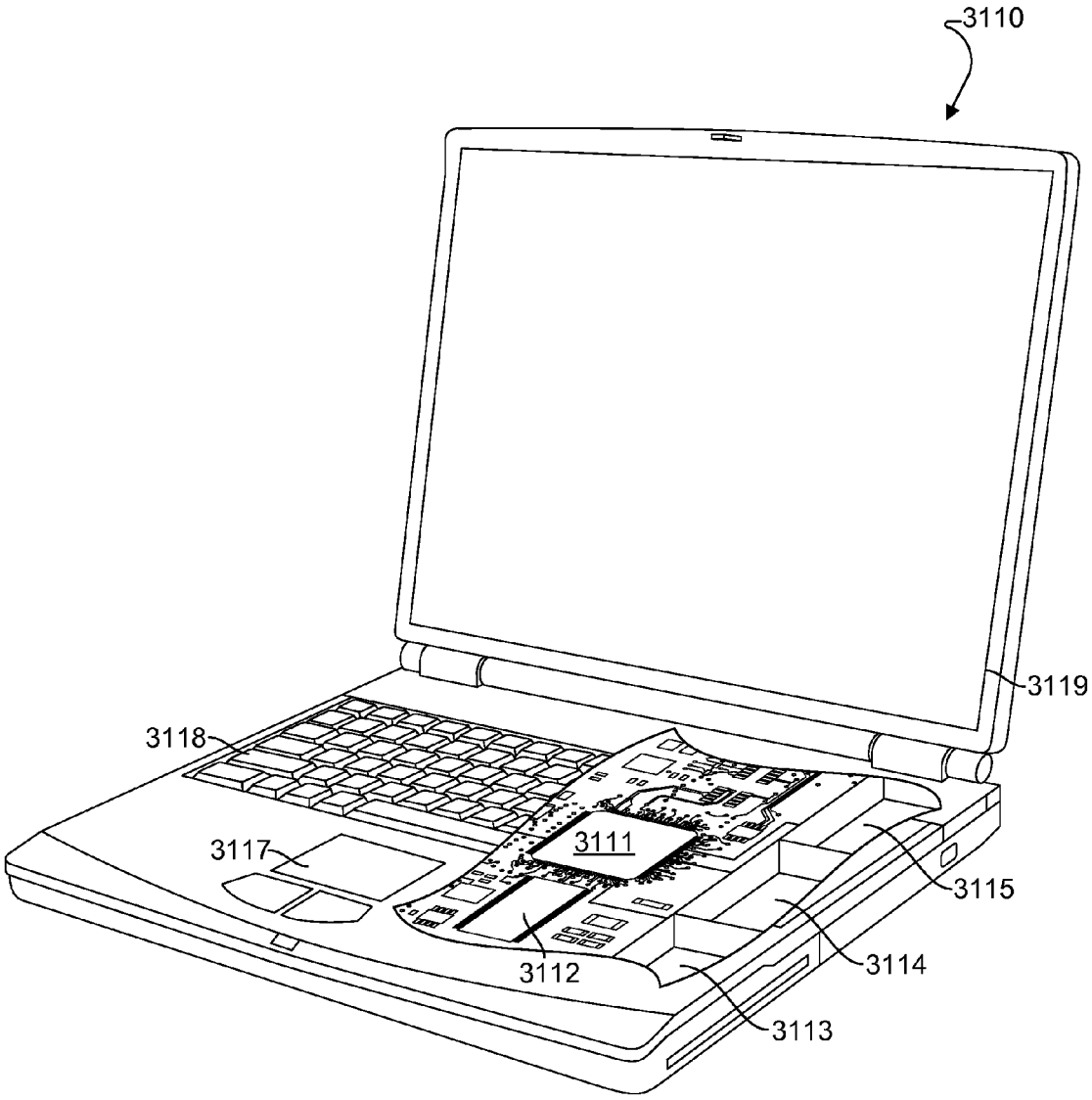

FIG. 31

DATA DELIVERY OPTIMIZATION

FIELD

The present invention relates generally to data transfer between computer devices and more particularly to methods and systems for optimizing the delivery of data to mobile devices.

BACKGROUND

Today's busy information worker may have multiple mobile devices all capable of working with data. As an example a traveler may have two mobile devices, such as a smart phone and a laptop computer. The smart phone and laptop computer may both be capable of manipulating and presenting the traveler with the same data, such as e-mail. While the smart phone and laptop computer may be capable of performing the same tasks, under various circumstances the user may prefer to work with one device over the other. For example, travelers may find occasionally checking e-mail on a smart phone useful, but may feel more productive doing involved work or reading on a laptop computer due to the laptop computer's generally larger screen and larger keyboard.

A common problem faced by many travelers involves synchronizing multiple mobile device data sets with a central database server when working in locations where all of the traveler's mobile devices may not have connectivity. As an example, a traveler may sync their laptop computer and smart phone with an e-mail exchange server prior to boarding an airplane, such that the laptop computer and smart phone are both up to date with respect to sent and received e-mail. The traveler may work on the airplane writing and answering e-mails on the laptop computer. Should the traveler write several e-mails on their laptop computer, which may be isolated from a network connection while in flight, those drafted e-mails may be held in a queue for transmission to the e-mail exchange server when a network connection becomes available. The traveler's laptop computer and smart phone would then be out of sync in terms of e-mail because the laptop computer would contain drafted e-mails which the smart phone does not. Upon landing, the traveler's smart phone may connect to a cellular data network and download the latest e-mail from the e-mail exchange server. The traveler may use their smart phone to write and answer e-mails in the airport, and the cellular data network connection may enable the smart phone and server to remain updated in terms of e-mail. However, the laptop computer will remain out of sync both in terms of both incoming and the outgoing e-mail until it establishes a network connection. The traveler may now be faced with a data synchronization problem because the laptop computer, smart phone, and e-mail exchange server may all contain different e-mail data sets. This data synchronization problem may cause the traveler frustration and hinder traveler productivity.

SUMMARY

The systems, methods, and devices of the various embodiments optimize the way in which data is delivered between mobile computing devices. The various embodiments leverage the interconnected nature of modern computing devices to optimize the delivery of a data set between a group of interconnected devices. In one embodiment a data set intended for a user having multiple computing devices may be segmented by an e-mail server and different portions of the data set may be transmitted to each of the user's computing devices. The two or more mobile computing devices may then share their data set portions with each other to recreate the complete data set on each computing device. In another embodiment, multiple computing devices each storing a complete data set may upload the complete data set to a single computing device (e.g., an e-mail server) by assigning upload responsibility for different segments of the complete data set to each device. Each of the multiple computing devices may upload their assigned segments to the single computing device. The single computing device may then combine the segments to recreate the complete data set.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated herein and constitute part of this specification, illustrate exemplary embodiments of the invention, and together with the general description given above and the detailed description given below, serve to explain the features of the invention.

FIG. **1** is a communication system block diagram of a network suitable for use with various embodiments.

FIG. **2** is a process flow diagram illustrating a first embodiment method for optimizing data delivery.

FIG. **3** is a schematic diagram of example data set characteristics.

FIG. **4** is a data structure diagram of example user preference settings.

FIG. **5** is a data structure diagram of example data segment map elements.

FIG. **6** is another process flow diagram illustrating a second embodiment method for optimizing data delivery.

FIG. **7** is a data structure diagram of example packet header information.

FIG. **8** is another process flow diagram illustrating a third embodiment method for optimizing data delivery.

FIG. **9** is another process flow diagram illustrating a fourth embodiment method for optimizing data delivery.

FIG. **10** is another process flow diagram illustrating a fifth embodiment method for optimizing data delivery.

FIG. **11** is another process flow diagram illustrating a sixth embodiment method for optimizing data delivery.

FIG. **12** is another process flow diagram illustrating a seventh embodiment method for optimizing data delivery.

FIGS. **13**A and **13**B are process flow diagrams illustrating an embodiment method for managing interactions between computing devices to optimize data delivery.

FIG. **14** is another process flow diagram illustrating an eighth embodiment method for optimizing data delivery.

FIG. **15** is a process flow diagram illustrating an embodiment method for synchronizing the transmission of data segments.

FIG. **16** is a process flow diagram illustrating an embodiment method for synchronizing the receipt of data segments.

FIG. **17** is a process flow diagram illustrating a first embodiment method for synchronizing a data set.

FIG. **18** is another process flow diagram illustrating a second embodiment method for synchronizing a data set.

FIG. **19** is a process flow diagram illustrating an embodiment method for assigning and transmitting data pending synchronization among computing devices.

FIG. **20** is a process flow diagram illustrating a first embodiment method for assigning upload responsibility.

FIG. **21** is another process flow diagram illustrating a second embodiment method for assigning upload responsibility.

FIG. **22** is another process flow diagram illustrating a third embodiment method for assigning upload responsibility.

FIG. **23** is another process flow diagram illustrating a fourth embodiment method for assigning upload responsibility.

FIG. **24** is another process flow diagram illustrating a fifth embodiment method for assigning upload responsibility.

FIG. **25** is a process flow diagram illustrating an embodiment method for directing the transmission of data pending synchronization among computing devices.

FIG. **26** is another process flow diagram illustrating another embodiment method for assigning and transmitting data pending synchronization among computing devices.

FIG. **27** is a process flow diagram illustrating an embodiment method for optimizing e-mail delivery.

FIGS. **28**A and **28**B are additional process flow diagrams illustrating another embodiment method for managing interactions between computing devices to optimize data delivery.

FIG. **29** is a component diagram of an example mobile computing device suitable for use with the various embodiments.

FIG. **30** is a component diagram of an example server suitable for use with the various embodiments.

FIG. **31** is a component diagram of another example mobile computing device suitable for use with the various embodiments.

DETAILED DESCRIPTION

The various embodiments will be described in detail with reference to the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts. References made to particular examples and implementations are for illustrative purposes, and are not intended to limit the scope of the invention or the claims.

The word "exemplary" is used herein to mean "serving as an example, instance, or illustration." Any implementation described herein as "exemplary" is not necessarily to be construed as preferred or advantageous over other implementations.

As used herein, the terms "mobile device" and "mobile computing device" refer to any one or all of cellular telephones, tablet computers, personal data assistants (PDAs), palm-top computers, notebook computers, laptop computers, personal computers, wireless electronic mail receivers and cellular telephone receivers (e.g., the Blackberry® and Treo® devices), multimedia Internet enabled cellular telephones (e.g., Blackberry Storm®), multimedia enabled smart phones (e.g., Android® and Apple iPhone®), and similar electronic devices that include a programmable processor, memory, a communication transceiver, and a display.

The various embodiments are described herein using the example of a traveler working with two mobile computing devices which synchronize data with a central database server (i.e., an e-mail server). This example is useful for describing the various components and functionality of the embodiment computing devices, systems and methods. However, the embodiments and the scope of the claims are not limited to such a configuration and application unless specifically recited. Describing the embodiments in terms of other potential applications would be unnecessary and repetitive. Thus, the term traveler is used herein to refer generally to any computing device user to which the embodiments could be applied, and is not intended to limit the scope of the claims unless specifically recited.

Similarly, the term e-mail is used herein to refer generally to any and all data to which the embodiments could be applied, including a variety of word, spread sheet, and multimedia files, and is not intended to limit the scope of the claims unless specifically recited.

The various embodiments are described herein using the term server. The term server is used to refer to any computing device capable of functioning as a server, such as a master exchange server, mail server, document server, or any other type of server. A server may be a dedicated computing device or a computing device running an application which may cause the computing device to operate as a server. A server application may be a full function server application, or a light or secondary server application that is configured to provide synchronization services among the dynamic databases on mobile computing devices. A light server or secondary server may be a slimmed-down version of server type functionality that can be implemented on a mobile computing device thereby enabling it to function as an Internet server (e.g., an enterprise e-mail server) only to the extent necessary to provide the functionality described herein.

In overview, the methods, systems, and devices of the various embodiments optimize the way in which data is delivered between computing devices. The various embodiments leverage the interconnected nature of modern computing devices to optimize the delivery of a data set between a group of interconnected computing devices. In one embodiment a data set intended for multiple mobile computing devices may be segmented and different portions of the data set may be provided to each mobile computing device. The intended mobile computing devices may then share their data set portions to recreate the complete data set on each mobile computing device. In another embodiment, multiple mobile computing devices each storing a complete data set may need to upload the complete data set to a single computing device. The multiple mobile computing devices may assign upload responsibility for segments of the complete data set among each other, and the multiple mobile computing devices may each upload their assigned segments to the single computing device. The single computing device may then combine the segments to recreate the complete data set.

In another embodiment a user's two or more mobile computing devices may be configured to recognize when one of the mobile computing devices is out of synchronization with the other in terms of a particular data set. If such a situation is detected, the mobile computing devices may accomplish an update or synchronization so that both mobile computing devices reflect a common data set. In another embodiment a mobile computing device may validate itself to other mobile computing devices so that synchronization is only accomplished between two mobile computing devices authorized by the user. In another embodiment, mobile computing devices may be configured to receive temporary data generated in one mobile computing device that is pending synchronization with another computing device, such as a server. In another embodiment, the mobile computing devices may be configured to translate data between applications to match the application format implemented on each mobile computing device. In a further embodiment, alternating or load-balancing of data delivery may be accomplished to optimize the overall speed or cost of data delivery. In a further embodiment conditional data delivery capabilities implemented on one or more of the mobile computing devices may de-conflict data delivery occurring simultaneously from multiple parties or multiple party e-mail threads.

FIG. **1** illustrates a network system **100** suitable for use with the various embodiments. The network system **100** may

include three devices, a server **102**, and two mobile computing devices, a smart phone **104** and a laptop computer **106**. While the various embodiments are particularly useful in relation to a server **102**, smart phone **104**, and laptop computer **106**, the embodiments are not limited to these devices and may be implemented in any device with no changes to the methods. Additionally, while the various embodiments are discussed in relation to interactions between three devices, the embodiments are not limited to three devices, and the methods may be implemented in network systems comprised of an unlimited number of devices.

The server **102** may be a master exchange server, mail server, document server, or any other type of central database server. The server **102** and the smart phone **104** may exchange data with each other via a communication pathway **108**. The laptop computer **106** and the server **102** may exchange data with each other via communication pathway **110**. The laptop computer **106** and the smart phone **104** may communicate with each other via the communication pathway **112**. The communication pathways **108**, **110**, and **112** may be used to transmit data between the devices. The communication pathways **108**, **110**, and **112** may be any connection type known in the art.

As an example, the communication pathways **108** and **110** used to connect to the server **102** may be wireless connections, such as a wireless Wi-Fi connection between the smart phone **104** and/or the laptop computer **106** and a Wi-Fi access point **118**. The Wi-Fi access point **118** may connect to the Internet **114**. The server **102** may be connected to the Internet **114**, and in this manner data may be transmitted from/to the smart phone **104** and/or the laptop computer **106** via the Wi-Fi access point **118**, and over the Internet **114** to/from the server **102** by methods well known in the art. As additional examples, communication pathways **108** and **110** may be established using a cellular network. The smart phone **104** and/or the laptop computer **106** may transmit data wirelessly to a cellular network cell tower or base station **116** which may connect to the Internet **114**. The server **102** may be connected to the Internet **114**, and in this manner data may be transmitted from/to the smart phone **104** and/or the laptop computer **106** via the wireless cellular tower or base station **116**, and over the Internet **114** to/from the server **102** by methods well known in the art. As a further example, the communication pathway **110** between the laptop computer **106** and the server **102** may be a wired local area network connection, such as an Ethernet connection **126**.

As an example, the communication pathway **112** between the smart phone **104** and the laptop **106** may be a wireless data link, such as a BlueTooth connection **120**. As an additional example, the communication pathway **112** between the smart phone **104** and the laptop computer **106** may be a wireless Wi-Fi data link via a Wi-Fi access point **122**. In this manner data may be transmitted from/to the smart phone **104** and/or the laptop computer **106** via the Wi-Fi access point **122** by methods well known in the art. As an additional example, the communication pathway **112** may also be a wired connection between the laptop computer **106** and smart phone **104**, such as a USB cable **124** connected between the devices.

The communication pathways **108**, **110**, and **112** may be any wired connections, such as a USB connection, a FireWire connection or local area network connection (e.g., Ethernet), as well as any wireless communication links, such as Bluetooth, Wi-Fi, ZigBee, cellular, CDMA, TDMA, GSM, PCS, G-3, G-4, LTE, or any other type wired or wireless connection. While the various aspects are particularly useful with the various embodiments, the communication pathways **108**, **110**, and **112** are not limited to these communication technologies and communication pathways **108**, **110**, and **112** may be established using any communication technology known in the art without changing the implementation of the embodiment methods.

FIG. **2** illustrates an embodiment method **200** for optimizing data delivery among three or more computing devices. As an example, the method **200** may be implemented between a server **102** and two or more mobile computing devices, such as a smart phone **104** and laptop computer **106**. While discussed in relation to a server **102**, smart phone **104**, and laptop computer **106**, the method **200** may be implemented in any device with the ability to act as a data server for other devices. At block **202** the server **102** may identify a data set to be communicated to the mobile computing devices. A data set may include any group of data, such as content objects, e-mails, lines of e-mails, text, blocks of text, web pages, parts of web pages, zip files, spread sheets, documents, portions of documents, files, and/or parts of files. At block **204** the server **102** may determine characteristics of the data set. Data set characteristics may include various characteristics discussed further below. At block **206** the server **102** may separate the data set into segments. A segment may include any grouping of the data within the data set, so the separation of the data set at block **206** may be performed based on the data set characteristics determined in block **204**, or the data set may be separated according to pre-determined parameters, such as a set segment size. At block **208** the server **102** may assign an identification ("ID") to each segment. This segment ID may be a unique number, name, or identification element generated by the server **102**. Additionally a segment ID may contain or provide information about the segment, such as information regarding the segment contents, the time of creation of the segment, the server **102**, or the segment size. At block **210** the server **102** may write the segment ID into each segment. The segment ID may be written into data representing the entire segment, or may be written into each data element comprising the individual segment.

At block **212** the server **102** may determine the total number of segments created from the data set. In block **214** the server **102** may determine the available mobile computing devices. Available mobile computing devices may be a smart phone **104** and a laptop computer **106**, for example, which may be connected to the server **102**. Alternatively, available mobile computing devices may be mobile computing devices that are registered with the server **102**, but that may not currently be connected to the server **102**. At determination block **216**, the server may determine whether the mobile computing devices are synchronization enabled. A synchronization enabled mobile computing device may be a mobile computing device that is capable of synchronizing/exchanging information with another mobile computing device. For example, a synchronization enabled smart phone **104** may be able to synchronize its data set with a data set of a synchronization enabled laptop computer **106**. If the available mobile computing devices are not synchronization enabled (i.e., determination block **216**="No"), in block **218** the server **102** may update the mobile computing devices independently with the entire data set.

If the available mobile computing devices are synchronization enabled (i.e., determination block **216**="Yes"), at block **220** the server **102** may determine the geographic location of the mobile computing devices. The server **102** may determine the geographic location of the mobile computing devices by global positioning system (GPS) information provided to the server **102** by the mobile computing devices, by reference to information about the connections through which the mobile computing devices may be communicating

to the server **102** (i.e., which cell network nodes the mobile computing devices may be using), through a mobile computing device user input identifying the location of each mobile computing device, or other methods. At determination block **222** the server may determine if the mobile computing devices are collocated. As examples, collocation may be determined by comparing mobile computing device GPS information, cellular network information, or user inputs. As an example, the server **102** may determine two mobile computing devices are more than a distance threshold setting apart based on GPS information. The distance threshold setting may be a maximum distance between devices defining collocation. If the mobile computing devices are not collocated (i.e., determination block **222**="No"), at block **218** the server **102** may update the mobile computing devices independently with the entire data set.

If the mobile computing devices are collocated (i.e., determination block **222**="Yes"), at block **224** the server **102** may determine the mobile computing device connection bandwidths. Alternatively, the server **102** may determine an estimated mobile computing device connection bandwidth for each mobile computing device based on the type of connection the mobile computing device may be using to communicate with the server **102**. At block **226** the server **102** may determine user preference settings. User preference settings may be related to connections or devices to use for updates. User preference settings are discussed below.

At block **228** the server **102**, may assign data segments to each mobile computing device. The assignments of data segments to each mobile computing device may be made based on various considerations discussed below. At block **230**, the server may generate a data segment map identifying each data segment and the mobile computing device to which each segment may be assigned or other elements as discussed below. At block **232** the server **102** may write data segment assignment information into each data segment. The data segment assignment information may be written into data representing the entire segment, or may be written into each data element comprising the individual segment. At block **234** the server **102** may transmit the data segments to their assigned mobile computing devices. In this manner each mobile computing device may receive different data segments. As an example, a laptop computer **106** may receive a first portion of the data segments and a smart phone **104** may receive a second portion of the data segments, such that the combination of the first and second portions will yield the entire data set. At block **236** the server **102** may transmit the data segment map to each mobile computing device. In this manner each mobile computing device may receive a copy of the entire data segment map. The data segment map may allow the individual mobile computing devices to determine the contents or the original data set even though each mobile computing device may not receive all the segments of the original data set from the server.

At block **238** the server **102** may store copies of the transmitted data segments and at block **240** the server **102** may store a copy of the data segment map. In this manner, the server **102** may be able to support future single device sessions, or retransmission of assigned data segments should a device connection fail.

FIG. **3** is a schematic diagram illustrating potential data set characteristics **302**. Data set characteristics **302** may include the calculated total size **304** of the data set. The total size **304** may be calculated in bytes or any other unit representative of the total size **304** of the data set. Data set characteristics **306** may also include the number of objects **206**, type of objects **308**, object priority **310**, and individual object size **312**.

FIG. **4** is a data structure diagram illustrating potential elements of user preference settings **402** which may be stored in a memory of a server **102**. User preference settings **402** may include a listing of devices to update **404**, an order of device updates **406**, a connection preference **408**, a speed preference **410**, a data limit for a device **412**, or a data preference **414**. As an example, a listing of devices to update **404** may identify a selected number of a user's mobile computing devices, enabling a user to control which devices are updated. As an example, an order of device updates **406** may direct a server **102** to update the selected devices in a particular order or priority sequence. As an example, a connection preference **408** may direct a server **102** to use a Wi-Fi connection rather than a CDMA connection. Alternatively, a connection preference **408** may direct a server **102** to use the least expensive connection among a group of available connections. As an example, a speed preference **410** may direct a server **102** to use the fastest connections available. As an example, a data limit for a device **412** may set a maximum amount of data to transmit from the server **102** to a device. As an example, a data preference **414** may direct a server **102** to assign a specific data type, such as e-mail, to a specific mobile device, such as a smart phone **104**.

FIG. **5** is a data structure diagram illustrating potential data segment map elements **502**. Data segment map elements **502** may include the total number of segments **504**, the segment IDs **506**, data set characteristics **508**, segment device assignments **510**, segment size **512**, a segment creation time stamp **514**, and a server validation key **516**. The data segment map elements **502** may be used individually or in combination by the server **102** or mobile devices to aid in recreating the data set, identifying the data set, or communicating between any of the server **102** and mobile devices. Specifically, a segment creation time stamp **514** may allow mobile devices to ensure they have the most up to date segments. A server validation key **516** may act as a trust/verification tool for mobile devices when communicating together and act as a security feature. The server validation key **516** may be provided by the server **102** as a way to validate the segments and/or mobile computing device to other mobile computing devices. The server validation key **516** may be an encrypted key provided from the server **102**. A mobile computing device receiving a server validation key **516** from a second mobile computing device may be able to use the serve validation key **516** to confirm that the information on the second mobile computing device actually originated at the server **102**.

FIG. **6** illustrates an embodiment method **600** for optimizing data delivery similar to method **200** described above with reference to FIG. **2**, except that at block **602** the server **102** may create a packet for each segment. At block **604** the server **102** may write header information into each packet. Header information may include various types of information as will be discussed further below. At block **214** the server **102** may determine available mobile computing devices. At block **606** the server **102** may assign packets to each mobile computing device in a manner similar to how data segments were assigned in block **228** discussed above. At block **230** the server **102** may generate a data segment map. At block **608** the server **102** may transmit the packets to their assigned mobile computing devices. At block **236** the server **102** may transmit the data segment map to the mobile computing devices.

FIG. **7** is a data structure diagram illustrating potential packet header information **702**. Packet header information **702** may include the segment ID **704**, a master data set ID **706**, a server ID **708**, a segment creation time stamp **710**, reassembly instructions **712**, and a packet creation time stamp **714**. A master data set ID **706** may be a unique identification created

by the server **102** to identify the overall data set from which the segments were created. The server ID **708** may be a unique identification associated with the server **102** that created the packet. The reassembly instructions **712** may be instructions controlling the order in which packets are intended to be unpacked or the placement in the overall data set of the segment contained in the packet. The packet creation time stamp **714** may be an indication of the time at which the packet was created.

FIG. **8** illustrates an embodiment method **800** for optimizing data delivery which may be used in conjunction with method **200** described above with reference to FIG. **2**. A discussed above in block **224**, the server **102** may determine the mobile computing device connection bandwidths for each mobile computing device. At block **802**, the server **102** may determine the total available bandwidth for all the mobile computing devices. As an example, the server **102** may sum the individual mobile computing device connection bandwidths to determine the total available bandwidth for all the mobile computing devices. At block **804** the server **102** may assign data segments to each mobile computing device in proportion to each mobile computing device's connection bandwidth as a percentage of the total available bandwidth. As an example a mobile computing device with a connection to the server representing 70% of the total available bandwidth between the two mobile computing devices may be assigned 70% of the data segments, while a mobile computing device with a connection to the server representing 30% of the total available bandwidth may be assigned 30% of the data segments. The server **102** may then transmit the data segments to the respective mobile computing devices as per methods **200** or **600** described above.

FIG. **9** illustrates an embodiment method **900** for optimizing data delivery which may be used in conjunction with method **200** described above with reference to FIG. **2**. As discussed above in block **224** the server **102** may determine the mobile computing device connection bandwidths. At block **902** the server **102** may determine data segment assignments that will result in the shortest estimated download time. At block **904** the server **102** may assign the data segments to each mobile computing device based on the determined shortest download time. The server **102** may then transmit the data segments to the respective mobile computing devices as per methods **200** or **600** described above.

FIG. **10** illustrates an embodiment method **1000** for optimizing data delivery which may be used in conjunction with method **200** described above with reference to FIG. **2**. At block **1002** the server **102** may determine the mobile computing device connection types. As an example, a connection between the server **102** and a smart phone **104** may be a 3G connection, and a connection between the server **102** and a laptop computer **106** may be a Wi-Fi connection. At block **1004** the server **102** may determine a cost associated with each mobile computing device connection. As an example, the server **102** may be provided information that a 3G connection results in a fee being charged to a user for data transmitted over the connection and that no fee is charged for data transmitted over a Wi-Fi connection. At block **1006** the server **102** may determine data segment assignments that will result in the lowest total download cost. At block **1008** the server **102** may assign data segments to each mobile computing device based on the determined lowest total download cost. In this manner, a server **102** implementing method **1000** may operate in a cost saving mode. The server **102** may then transmit the data segments to the respective mobile computing devices as per methods **200** or **600** described above.

FIG. **11** illustrates an embodiment method **1100** for optimizing data delivery similar to methods **200** and **800** above described with reference to FIGS. **2** and **8**, except that data segmentation may address changes in mobile computing device connection bandwidth. As discussed above, at block **234** the server **102** may transmit the data segments to the assigned mobile computing devices. At determination block **1102** the server **102** may determine if a bandwidth change in any mobile computing device connection has occurred. If a bandwidth change has occurred (i.e., determination block **1102**="Yes"), at block **224** the server **102** may again determine the mobile computing device connection bandwidths. At block **802** the server **102** may again determine the total available bandwidth. At block **804** the server **102** may again assign data segments to each mobile computing device in proportion to each mobile computing device's connection bandwidth as a percentage of total available bandwidth, and at block **234** the server **102** may transmit the data segments to their now potentially newly assigned mobile computing devices. In this manner, the server **102** may continually adjust the assignment of data segments as bandwidth changes during data segment transmission.

If the bandwidth does not change in any mobile computing device (i.e., determination block **1102**="No"), at block **1104** the server **102** may generate a data segment map. In this manner, the data segment map may not be generated until the data segment assignments are finalized. At block **236**, the server **102** may transmit the data segment map to the mobile devices.

FIG. **12** illustrates an embodiment method **1200** for optimizing data delivery similar to method **1100** described above with reference to FIG. **11**, except that data segmentation may compensate for the loss of a mobile computing device connection. As discussed above, at block **234** the server **102** may transmit data segments to the assigned mobile computing devices. At determination block **1202** the server may determine if a mobile computing device connection is lost. If a mobile computing device connection is lost (i.e., determination block **1202**="Yes"), at block **1204** the server **102** may transmit a full download query to the remaining mobile computing devices. As an example, a full download query may be an indication to an application running on a mobile computing device to prompt the user to approve or disapprove the full download of the entire data set. If a mobile computing device connection is not lost (i.e., determination block **1202**="No"), at block **1104** the server **102** may generate a data segment map and at block **235** the server **102** may transmit the data segment map to the mobile computing devices. The server **102** may then transmit the data segments to the respective mobile computing devices as per methods **200** or **600** described above.

At determination block **1206** the server **102** may determine whether a full download indication is received. As an example, a full download indication may be a message received from an application running on a mobile computing device indicating that the user requests a full download of the entire data set. If a full download indication is received (i.e., determination block **1206**="Yes"), at block **1208** the server may transmit the entire data set to the remaining connected mobile computing devices. If a full download indication is not received (i.e., determination block **1206**="No"), at block **1104** the server **102** may generate a data segment map and at block **235** the server **102** may transmit the data segment map to the mobile computing devices. The server **102** may then transmit the data segments to the respective mobile computing devices as per methods **200** or **600** described above.

FIGS. **13**A and **13**B illustrate another embodiment method **1300** for managing interactions between a server **102**, a smart

phone **104**, and a laptop computer **106** to optimize data delivery. At blocks **202**, **206**, **208**, and **210** the server **102** may perform operations of method **200** described above with reference to FIG. **2**. At block **1302** and block **1304** the server **102** and the smart phone **104** may establish a data communication connection. The connection may be any connection suitable for transmitting data, such as those connections discussed previously in relation to FIG. **1**. At block **1306** and block **1308** the server **102** and laptop computer **106** may establish a data communication connection. The connection may be any connection suitable for transmitting data, such as those connections discussed previously in relation to FIG. **1**. At blocks **214**, **228**, **230**, and **232** the server **102** may perform operations of method **200** described above with reference to FIG. **2**.

At block **1310** the server **102** may transmit the assigned data segments to the smart phone **104**. At block **1312** the smart phone **104** may receive its assigned data segments. At block **1314** the server **102** may transmit assigned data segments assigned to the laptop computer **106**. At block **1316** the laptop computer **106** may receive its assigned data segments. At block **1318** the server **102** may transmit the data segment map to the smart phone **104**. At block **1320** the smart phone **104** may receive the data segment map. At block **1322** the server **102** may transmit the data segment map to the laptop computer **106**. At block **1324** the laptop computer **106** may receive the data segment map.

At block **1326** and block **1328** the smart phone **104** and the laptop computer **106** may establish a data communication connection with each other. The connection may be any connection suitable for transmitting data, such as those connections discussed previously in relation to FIG. **1**. At block **1330** the smart phone **104** may determine what data segments to transmit to the laptop computer **106**. The determination may be based at least in part on information in the data segment map received by the smart phone **104**. At block **1332** the laptop computer **106** may select data segments to transmit to the smart phone **104**. The selection may be based at least in part on the information in the data segment map received by the laptop computer **106**. At block **1334** the smart phone **104** may transmit selected data segments to the laptop computer **106** and at block **1336** the laptop computer **106** may receive the data segments. At block **1338** the laptop computer **106** may transmit selected data segments to the smart phone **104**, and at block **1340** the smart phone **104** may receive the data segments. In this manner, the full data set resident on the server **102**, may be assembled in both the smart phone **104** and the laptop computer **106**.

FIG. **14** illustrates an embodiment method **1400** for optimizing data delivery which may be used in conjunction with method **200** describe above with reference to FIG. **2**. At block **1402** the server **102** may determine the mobile computing device types with which the server **102** has established connections. As an example, the server **102** may determine that the mobile computing devices are two different types of devices, i.e. a smart phone **104**, and a laptop computer **106**. At block **1404** the server **102** may determine the amount of each data segment to send based on the mobile computing device types. In this manner the server may determine a portion of the data to be sent to each mobile computing device based on the type of device. As an example, a smart phone **104** may only be able to receive and display the first three lines of an e-mail message. When the server **102** determines that the smart phone **104** is connected, the server **102** may determine that only a limited amount of the data segment (i.e., the first three lines of the e-mail message) should be sent to the smart phone **104**. In block **228** the server **102** may assign data segments to each mobile device. In block **1406** the server **102** may transmit the appropriate amount of each of the data segments assigned to the mobile computing devices based on the determined device capabilities. In this manner only a portion of the data segment (i.e., the determined amount) may be transmitted to a mobile computing device.

FIG. **15** illustrates an embodiment method **1500** for synchronizing the transmission of data segments from a first computing device to a second computing device. As an example, the method **1500** may be implemented between two mobile computing devices, such as a smart phone **104** and a laptop computer **106**. While discussed in relation to two mobile computing devices (e.g., the smart phone **104** and the laptop computer **106**) the method **1500** may be implemented among any number of computing devices, mobile or otherwise. In block **1502** a first mobile computing device, such as a smart phone **104**, may detect an available data communication link to another mobile computing device, such as a laptop computer **106**. The first mobile computing device may detect the availability of the data link to the second mobile computing device through a previously established connection such as a Bluetooth connection. At determination block **1504** the first mobile computing device may determine if it has a data segment for the second mobile computing device. As an example, the determination at block **1504** may be made by comparing a device ID for the laptop computer **106** to a data segment map resident in a memory of the smart phone **104** which may indicate whether a data segment should be provided to the laptop computer **106**. If the first mobile computing device does not have a data segment for the second mobile computing device (i.e., determination block **1504**="No"), the first mobile computing device may return to block **1502** to await detection of another mobile computing device.

If there is a data segment for the second mobile computing device (i.e., determination block **1504**="Yes"), in an optional embodiment at block **1506** the first mobile computing device may determine the available mobile device data communication link connections to the second mobile computing device. Mobile computing devices may have the ability to establish more than one data communication link, and more than one data communication link may be established between the first and second mobile computing devices. As an example the smart phone **104** may determine there is both a Wi-Fi connection and a BlueTooth connection with the laptop computer **106**. At block **1508**, in this optional embodiment, the first mobile computing device may select an available mobile device data communication link connection established between the first and second mobile computing device. As an example, at block **1508** the smart phone **104** may select the BlueTooth connection. Selections of communication data link connections may be made in any manner, and may be made based on considerations similar to those discussed above in relation to FIGS. **8**, **9**, and **10**, such as cost or speed.

At block **1510** the first mobile computing device may transmit a data waiting message to the second mobile computing device. The data waiting message may alert the second device that the first device has a data segment intended for a second device. Additionally, a data waiting message may include a listing of data segments intended for the second mobile computing device, information about a data segment such as its size, creation date, or content type, or any other information related to a data segment intended for the second mobile computing device. At block **1512** the first mobile computing device may receive a validation request from the second mobile computing device. The validation request may be a request from the second mobile computing device in response to the data waiting message. The validation request may be a request for information which may used by the second mobile

device to validate the authenticity of the first mobile computing device or to validate the authenticity of the data resident on the first mobile computing device. As an example, the validation request may request the first mobile computing device provide the identity of a server from which the data segment originated. The second mobile computing device may use the identity of the server to validate that the segment originated on an authorized server, and thus a validation request may prevent the unauthorized parties from providing or receiving data.

At block **1514** the first mobile computing device may transmit a data segment map to the second mobile computing device in response to receiving the validation request. The data segment map may contain information to be used by the second mobile computing device to validate the authenticity of the first mobile computing device or to validate the authenticity of the data resident on the first mobile computing device. As an example, the data segment map may contain a server ID to identify the server from which the data segment originated. The second mobile computing device may user the server ID to validate the first mobile computing device (e.g., by comparing the server ID to a stored list of authorized server IDs). At determination block **1516** the first mobile computing device may determine if a data segment transmit request is received. If a data transmit request is not received (i.e., determination block **1516**="No"), the first mobile computing device may return to block **1502** to await detection of another mobile computing device. If a data transmit request is received (i.e., determination block **1516**="Yes"), at block **1518** the first mobile computing device may transmit the data segment to the second mobile computing device.

FIG. **16** illustrates an embodiment method **1600** for synchronizing the receipt of data segments from a first computing device at a second computing device. As an example, the method **1600** may be implemented by a second mobile computing device operating in conjunction with a first mobile computing device implementing method **1500**. As an example, the method **1600** may be implemented between two mobile computing devices, such as first mobile computing device, a smart phone **104** and a second mobile computing device, a laptop computer **106**. While discussed in relation to two mobile computing devices (laptop computer **106** and smart phone **104**) the method **1600** may be implemented among any number of computing devices, mobile or otherwise. At block **1602** a second mobile computing device, such as laptop computer **106**, may receive a data waiting message from a first mobile computing device, such as smart phone **104**. As discussed above, the data waiting message may be a message alerting the second device that the first device has a data segment intended for the second mobile computing device. Additionally, a data waiting message may include a listing of data segments intended for the second mobile computing device, information about a data segment such as its size, creation date, or content type, or any other information related to a data segment intended for the second mobile computing device.

At block **1604** the second mobile computing device may transmit a validation request to the first mobile computing device. The validation request may be sent from the second mobile computing device in response to the second mobile computing device receiving the data waiting message. As discussed above, the validation request may be a request for information which may used by the second mobile device to validate the authenticity of the first mobile computing device or to validate the authenticity of the data resident on the first mobile computing device. As an example, the validation request may be a message sent from the laptop computer **106** to the smart phone **104** requesting the smart phone **104** provide a server ID. At block **1608** the second mobile computing device may receive a data segment map from the first mobile computing device which may contain a server ID.

At determination block **1610** the second mobile computing device may determine if the server ID is valid, such as by comparing the server ID in the data segment map to a server ID stored in memory. Other methods may be used to validate the server ID, including the use of encrypted hash techniques well known in the computer arts. If the server ID is not validated (i.e., determination block **1610**="No"), at block **1620** the method may end. In this manner, invalid and/or untrusted data may not be received by the second mobile computing device. If the server ID is valid (i.e., determination block **1610**="Yes"), at block **1612** the second mobile computing device may compare the data segment map to a current data set resident on the second mobile computing device to determine is any data segments on the first mobile computing device contain data not resident on the second mobile computing device. As an example, the laptop computer **106** may compare the data segment creation time stamps to determine if the data set on the laptop computer **106** is newer than the data set defined by the data segment map.

At determination block **1614** the second mobile computing device may determine if the data segment is required. This determination may be made using the results of the comparison of the data segment to the current data set performed in block **1612** to determine if any data segments on the first mobile computing device contain data not resident on the second mobile computing device. Required data segments may include data not resident on the second mobile computing device or data newer than the data resident on the second mobile computing device. If the data segment is not required (i.e., determination block **1614**="No"), at block **1620** the method **1600** may end. As an example, an outdated data segment may not be required. If the data segment is required (i.e., determination block **1614**="Yes"), at block **1616** the second mobile computing device may transmit a data segment transmit request to the first mobile computing device requesting the transmission of the data segment. At block **1618** the second mobile computing device may receive the data segment from the first mobile computing device. At block **1620** the method **1600** may end.

FIG. **17** illustrates an embodiment method **1700** for synchronizing a data set between a first computing device and a second computing device. As an example, the method **1700** may be implemented between two mobile computing devices, such as a smart phone **104** and a laptop computer **106**. While discussed in relation to two mobile computing devices (smart phone **104** and laptop computer **106**) the method **1700** may be implemented among any number of computing devices, mobile or otherwise. At block **1702** the first mobile computing device, such as laptop computer **106**, may mark data pending server synchronization as temporary. Data pending server synchronization may be data which has been altered in some way since the last data synchronization between the first mobile computing device and a server occurred. Data pending server synchronization may be marked temporary in any manner, including by information written into a file header, a tag added to the data or an index or a pointer file, or by changing a data ID. At block **1704** the first mobile computing device may transmit a data listing to the second mobile computing device, such as the smart phone **104**. A data listing may be a listing of data resident on the first mobile computing device, such as an index. The data listing may include an identification of data marked as temporary in block **1702**. As an example the laptop computer **106** may

transmit the data listing to a smart phone **104** over a communication data link connection established between the laptop computer **106** and the smart phone **104**.

At block **1706** the first mobile computing device may receive a data set request from the second mobile computing device. A data set request may identify all or a portion of the data on the data listing which may be required by the second mobile computing device. Additionally, the data set request may include information about the application format for data required by the second mobile computing device. At block **1708** the first mobile computing device may identify the data set required by the second mobile computing device based on the data listing received at block **1706**. Identification of the data set may include identifying an application format required by the second mobile computing device. At block **1710** first mobile computing device may translate the data set between application formats. As an example, the data stored on the laptop **106** may be in an application format only suitable for use on the laptop **106**. To make use of the data, the smart phone **104** may require the data be translated into an application format suitable for use on the smart phone **104**. Therefore, the laptop **106** may translate the data set from an application format for the laptop **106** to an application format for the smart phone **104**. At block **1712**, the first mobile computing device may transmit the now translated data set to the second mobile computing device. As an example, the laptop computer **106** may transmit the translated data set to the smart phone **104** over a communication data link connection established between the laptop computer **106** and the smart phone **104**.

FIG. **18** illustrates an embodiment method **1800** for synchronizing a data set between a first computing device and a second computing device. As an example, the method **1800** may be implemented by a second mobile computing device operating in conjunction with a first mobile computing device implementing method **1700**. As an example, the method **1800** may be implemented between two mobile computing devices, such as first mobile computing device, a laptop computer **106** and a second mobile computing device, a smart phone **104**. While discussed in relation to two mobile computing devices (laptop computer **106** and smart phone **104**) the method **1800** may be implemented among any number of computing devices, mobile or otherwise. At block **1802** a second mobile computing device, such as the smart phone **104**, may receive a data listing from a first mobile computing device, such as the laptop **106**. As discussed above, a data listing may be a listing of data resident on the first mobile computing device and may include an identification of data marked as temporary.

At block **1804** the second mobile computing device may compare the data listing to data resident on the second mobile computing device. At determination block **1806** the second mobile computing device may determine if it requires data on the data listing. This determination may be made using the results of the comparison of the data listing to the data resident on the second mobile computing device performed in block **1804**. Required data may include data not resident on the second mobile computing device, data newer than the data resident on the second mobile computing device, or data marked as temporary. If data on the data listing is not required (i.e., determination block **1806**="No"), at block **1808** the method **1800** may end.

If data on the data listing is required (i.e., determination block **1806**="Yes"), at block **1810** the second mobile computing device may transmit a data set request to the first mobile computing device. As discussed above, a data set request may identify all or a portion of the data on the data listing which may be required by the second mobile computing device and may include information about the application format for data required by the second mobile computing device. At block **1812** the second mobile computing device may receive a data set from the first mobile computing device. A data set may include the data requested by the second mobile computing device translated into an application format suitable for use on the second mobile computing device. At block **1814** the second mobile computing device may update the data resident on the second mobile computing device with the received data set. At block **1808** the method **1800** may end.

FIG. **19** illustrates an embodiment method **1900** for assigning and transmitting data pending synchronization among computing devices. As an example, the method **1900** may be implemented between a first mobile computing device, such as laptop computer **106**, a second mobile computing device, such as a smart phone **104**, and a server **102**. While discussed in relation to a laptop computer **106**, smart phone **104**, and server **102**, the method **1900** may be implemented among an unlimited number of devices. At block **1902** a first mobile computing device, such as the laptop computer **106**, may establish a communication data link connection with a second mobile computing device, such as the smart phone **104**. The communication data link connection may be any type of connection, as discussed above with reference to FIG. **1**. At block **1904** the first mobile computing device may synchronize a data set between the first mobile computing device and the second mobile computing device. Synchronization of the data set may be accomplished by any method, such as by implementing any of the methods discussed above with reference to FIGS. **15**, **16**, **17**, and **18**. Synchronization of the data set between the first mobile computing device and the second mobile computing device may result in an identical data set being resident on both the first mobile computing device and the second mobile computing device.

At block **1906** the first mobile computing device may determine whether any data in the now synchronized data set is pending server synchronization. Data pending server synchronization may be data which has been altered in some way since the last data synchronization between the first mobile computing device and the server **102**. The first mobile computing device may determine data is pending server synchronization by reading file header information, recognizing a tag associated with the data, referencing a data segment map, or by receiving a user input indicating the data is pending server synchronization.

At block **1908** the first mobile computing device may separate the data pending server synchronization into segments. A segment may include any grouping of the data pending server synchronization, and the separation of the data may be performed based on data characteristics, or the data pending server synchronization may be separated according to predetermined parameters, such as a set segment size. At block **1910** the first mobile computing device may assign an identification ("ID") to each pending segment. This pending segment ID may be a unique number, name, or identification element generated by the first mobile computing device. Additionally, a pending segment ID may contain or provide information about the segment, such as information regarding the segment contents, the time of creation of the segment, the first mobile computing device, the second mobile computing device, and intended server, or the segment size. At block **1912** the first mobile computing device may write the pending segment ID into each pending segment. The pending segment

ID may be written into data representing the entire segment, or may be written into each data element comprising the individual pending segment.

At block **1914** the first mobile computing device may assign an upload responsibility for each pending segment. An upload responsibility may be an assignment for a specific mobile computing device to transmit a specific pending segment to a server. As an example, the laptop computer **106** may assign half the pending segments to the smart phone **104** for upload, and may assign the other half the pending segments to itself for upload. Assignment considerations are discussed further below. At block **1916** first mobile computing device may synchronize the pending segments and pending segment IDs with the second mobile computing device. Synchronization of the pending segments and pending segment IDs may result in the first and second mobile computing devices having similar data sets with similar pending segments and similar pending segment IDs. As an example, synchronization of the pending segments and pending segment IDs may be accomplished by the first mobile computing device transmitting the pending segments and pending segment IDs to the second mobile computing device. The first mobile computing device may transmit all of the pending segments and pending segment IDs to the second mobile computing device, or alternatively may transmit only the portion of the pending segments and pending segment IDs assigned to the second mobile computing device. In an alternative example, the first mobile computing device may transmit instructions to the second mobile computing device for the second mobile computing device to use in creating identical pending segments and pending segment IDs. The instructions may include information such as the data included in each pending segment, a starting point for the data pending server synchronization and standard pending segment size, a pending segment ID numbering scheme, or other information enabling the second mobile computing device to recreate the pending data segments and pending segment IDs.

At block **1918** the first mobile computing device may transmit the upload responsibilities for each pending segment to the second mobile computing device. At block **1920** the first mobile computing device may terminate its communication data link connection with the second mobile computing device. At block **1922**, the first mobile computing device may establish a communication data link connection with the server **102**. The connection may be any type of connection, as discussed above with reference to FIG. **1**. At block **1924**, the first mobile computing device may transmit its assigned pending segments to the server **102**. At determination block **1926**, the first mobile computing device may determine if a full upload request is received from the server **102**. A full upload request may be a message received from the server **102** indicating that the server **102** requests a full upload of all data pending synchronization. As an example, a full upload request may be sent by the server **102** in response to an indication that the second mobile computing device, such as the smart phone **104**, has been lost, damaged, or destroyed. If a full upload request is not received (i.e., determination block **1926**="No"), at block **1930** the first mobile device may terminate its communication data link connection with the server **102**. If a full upload request is received (i.e., determination block **1926**="Yes"), at block **1926** the first mobile computing device may transmit all the remaining pending segments to the server **102**. As an example, the first mobile device may transmit the pending segments assigned to the second mobile device. In this manner the server **102** may be updated with all pending segments by the first mobile computing device and all data which was pending server synchronization may be provided to the server **102** despite the loss, damage, or destruction of the second mobile device. At block **1930** the first mobile device may terminate its communication data link connection with the server **102**.

FIG. **20** illustrates an embodiment method **2000** for assigning upload responsibility which may be used in conjunction with method **1900** described above. In block **2002** the first mobile computing device may determine the estimated bandwidth available in both the first and second mobile computing device's data communication link connections to a server **102**. As an example, the laptop computer **106** may determine the estimated connection bandwidth for its connection to the server **102** and the estimated connection bandwidth for a connection between the smart phone **104** and the server **102**. The determination of the estimated connection bandwidths may be made by information received from each mobile computing device about its communication data link connection with the server **102** or stored bandwidth estimates for a device and/or connection type. At block **2004**, first mobile computing device may determine the estimated total available bandwidth to a server **102** available using the first and second mobile computing devices by combining the estimated bandwidths for both mobile computing devices. At block **2006** the first mobile computing device may assign upload responsibility for each pending segment to a mobile computing device in proportion to that mobile computing device's estimated connection bandwidth with the server **102** as a percentage of total estimated total available bandwidth to the server **102**. As an example the first mobile computing device may have a communication data link connection to the server **102** representing 70% of the total available bandwidth and the first mobile computing device may be assigned 70% of the data segments for transmission, while the second mobile computing device may have a communication data link connection to the server **102** representing 30% of the total available bandwidth and the second mobile computing device may be assigned 30% of the data segments for transmission. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **21** illustrates an embodiment method **2100** for assigning upload responsibility which may be used in conjunction with method **1900** described above. As discussed above, in block **2002** the first mobile computing device may determine the estimated bandwidth available in both the first and second mobile computing device's data communication link connections to a server **102**. At block **2104** the first mobile computing device may determine data upload responsibilities that will result in the shortest estimated upload time. At block **2106** the first mobile computing device may assign upload responsibility for each segment to a mobile computing device based on the determined shortest download time. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **22** illustrates an embodiment method **2200** for assigning upload responsibility which may be used in conjunction with method **1900** described above. At block **2202** the first mobile computing device may determine the mobile computing device to server **102** communication data link connection types. As an example, a communication data link connection between the server **102** and a smart phone **104** may be a 3G connection and a communication data link connection between the server **102** and a laptop computer **106** may be a Wi-Fi connection. At block **2204** the first mobile computing device may determine a data transmission cost associated with each mobile device to server **102** communication data

link connection. As an example, the laptop computer **106** may be provided information that a 3G connection results in a fee being charged to a user for data transmitted over the connection and that no fee is charged for data transmitted over a Wi-Fi connection. At block **2206** the first mobile computing device may determine data upload responsibilities that will result in the lowest total upload cost. At block **2208** the first mobile computing device may assign upload responsibility for each pending segment to a mobile computing device based on the determined lowest total upload cost. In this manner, a first mobile computing device implementing method **2200** may operate in a cost saving mode. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **23** illustrates an embodiment method **2300** for assigning upload responsibility which may be used in conjunction with method **1900** described above. At block **2302** the first mobile computing device may determine the total number of pending segments to be transmitted to the server **102**. At block **2304** the first mobile computing device may assign upload responsibility for some fraction (e.g., half) the total number of pending segments to the first mobile computing device, such as the laptop computer **106**, and upload responsibility for the other fraction of the total number of pending segments to the second mobile computing device, such as the smart phone **104**. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **24** illustrates an embodiment method **2400** for assigning upload responsibility which may be used in conjunction with method **1900** described above. At block **2402** the first mobile computing device may identify pending segments as even or odd segments. As an example the laptop computer **106** may write an even or odd identifying string into a data header for each segment. At block **2404** the first mobile computing device may assign upload responsibility for even pending segments to the first mobile device, such as the laptop computer **106**, and upload responsibility for odd pending segments to the second mobile device, such as the smart phone **104**. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **25** illustrates an embodiment method **2500** for directing the transmission of data pending synchronization among computing devices which may be used in conjunction with method **1900** described above. In block **2502** a server **102** may direct a first mobile computing device, such as a laptop computer **106**, to upload a portion of the pending segments for which the first mobile computing device is not assigned an upload responsibility. As an example, a user input indicating that a second mobile device, such as the smart phone **104**, which may have been assigned data segments to upload is lost, may trigger the server **102** to direct the first mobile computing device, such as laptop computer **106**, to upload the portion of the pending segments originally assigned to the now lost smart phone **104**. The direction from the server **102** to the first mobile computing device may be in the form of a full upload request sent to the first mobile computing device. In this manner, the loss or destruction of a mobile computing device may not result in the loss of data segments pending server synchronization. The first and second mobile computing devices may then complete the uploading of data to the server **102** per method **1900** as described above.

FIG. **26** illustrates an embodiment method **2600** for assigning and transmitting data pending synchronization among computing devices similar to method **1900**, with the addition of an upload status determination. At block **2602**, the first mobile computing device may request the second mobile computing device's upload status from the server **102**. At block **2604** the first mobile computing device may receive second mobile computing device's upload status from the server **102**. As an example, the laptop computer **106** may receive a message from the server **102** indicating the smart phone **104**, has not uploaded. At determination block **2606**, the first mobile computing device may use the information received in block **2604** to determine if the second mobile computing device has uploaded. If the second mobile computing device has not uploaded (i.e., determination block **2606**="No"), the first mobile computing device may transmit all remaining pending segments to the server **102** in block **1928**. If the second mobile computing device has upload (i.e., determination block **2606**="Yes"), at block **1930** the first mobile computing device may terminate its communication data link connection with the server **102**.

FIG. **27** illustrates an embodiment method **2700** for optimizing delivery of e-mails. Embodiment method **2700** may be implemented on a first mobile computing device, such as a laptop computer **106**, which may synchronize a data set with a second mobile computing device, such as a smart phone **104**, and which may provide an assigned portion of the data set to a server **102**. While discussed in relation to three devices, method **2700** may be implemented among more than three devices. In block **2702** the first mobile computing device may establish a communication data link connection with the second mobile computing device. The communication data link connection may be any type of connection, as discussed above with reference to FIG. **1**. At block **2704** the first mobile computing device may synchronize an e-mail set between the first mobile computing device and the second mobile computing device. The e-mail set may be synchronized by any method, for example those discussed above with reference to FIGS. **15**, **16**, **17**, and **18**. At block **2706** the first mobile computing device may determine e-mails pending for synchronization with the server **102**.

At block **2708** the first mobile computing device may assign an upload responsibility for each pending segment. An upload responsibility may be an assignment for a specific mobile computing device to transmit a specific pending e-mail to the server **102**. In this manner each pending e-mail may be assigned to a different mobile computing device for upload. As an example, the laptop computer **106** may assign half the e-mails to the smart phone **104** for upload, and the other half of the e-mails to itself for upload. At block **2710** the first mobile computing device may transmit the upload responsibilities for each pending e-mail to the second mobile computing device. At block **2712**, the first mobile computing device may establish a communication data link connection with the server **102**. The communication data link connection may be any type of connection, as discussed above with reference to FIG. **1**.

At block **2714** the first mobile computing device may request the server **102** provide the first mobile computing device with an e-mail thread status. An e-mail thread status may an indication of the time of receipt of the most recent e-mail in an e-mail thread or a listing of all e-mails in an e-mail thread resident on the server **102**. At block **2716** the first mobile computing device may receive a message from the server **102** providing the e-mail thread status. In this manner the first mobile computing device may be updated with the current status of each e-mail thread. At determination block **2718** the first mobile computing device may determine if more recent e-mails are in a thread using information in the e-mail thread status received in block **2716**. As an example,

the laptop computer **106** may have been disconnected from the server **102** for a period of time. During that disconnected period a laptop computer **106** user may have drafted e-mails in response to e-mails received before the laptop computer **106** was disconnected from the server **102**. While the laptop computer **106** was disconnected, other recipients may have exchanged e-mails so the e-mail thread may have e-mails more recent than those stored on the laptop computer **106**. If the first mobile computing device determines there are more recent e-mails in a thread (i.e., determination block **2718**="Yes"), in block **2720** the first mobile computing device may request user approval to transmit its assigned pending e-mails. As an example, user approval may be requested via a pop-up window or other type user prompt displayed by first mobile computing device. If the first mobile computing device determines there are no more recent e-mails in the thread (i.e., determination block **2718**="No"), at block **2722** the first mobile computing device may transmit its assigned pending e-mails to the server **102**.

At determination block **2724** the first mobile computing device may determine if the user approved transmitting its assigned pending e-mails to the server. User approval may be received as a user input, such as a button push or display selection indication. If user approval is received (i.e., determination block **2724**="Yes"), at block **2722** the first mobile computing device may transmit its assigned pending e-mails to the server **102**. If user approval is not received (i.e., determination block **2724**="No"), at block **2726** the first mobile computing device may hold its assigned pending e-mails. In this manner, e-mails which are outdated compared to the progress of the e-mails in the thread may be held and a user may avoid causing confusion in an e-mail thread by responding to outdated e-mails.

FIGS. **28**A and **28**B illustrate another embodiment method **2800** for managing interactions between a server **102**, a smart phone **104**, and a laptop computer **106** to optimize data delivery. At blocks **1902**, **1904**, **1906**, **1908**, **1910**, **1912**, **1914**, **1916**, **1918**, **1920**, **1922**, **1924**, and **1930** the laptop computer **106** may perform operations of method **1900** described above with reference to FIG. **19**. At block **2802** and **1902** the smart phone **104** and laptop computer **106** may establish a communication data link connection. The communication data link connection may be any connection suitable for transmitting data, such as those connections previously discussed previously in relation to FIG. **1**. At blocks **2804** and **1904** the smart phone **104** and laptop computer **106** may synchronize a data set between themselves as accomplished in method **1900**. At blocks **2806** and **1916** the smart phone **104** and laptop computer **106** may synchronized the pending segments and pending segment IDs as accomplished in method **1900**.

At block **2808** the smart phone **104** may receive the upload responsibilities for each pending segment from the laptop **106**. In this transmission the smart phone **104** may receive an indication of both its own upload responsibilities and that of the laptop computer **106**. At blocks **2810** and **1920** the smart phone **104** and laptop computer **106** may terminate their communication data link connections with each other.

At blocks **1922** and **2812** the laptop computer **106** and server **102** may establish a communication data link connection. The communication data link connection may be any connection suitable for transmitting data, such as those connections previously discussed previously in relation to FIG. **1**. At blocks **2814** and **2186** the smart phone **104** and the server **102** may establish a communication data link connection. The communication data link connection may be any connection suitable for transmitting data, such as those connections previously discussed previously in relation to FIG. **1**. At block **1924** the laptop computer **106** may transmit its assigned pending segments to the server **102**. At block **2818** the server **102** may receive the transmitted pending segments assigned to the laptop computer **106**. At block **2820** the smart phone **104** may transmit its assigned pending segments to the server **102**. At block **2822** the server **102** may receive the transmitted pending segments assigned to the smart phone **104**. In this manner, the full set of pending segments may be assembled in the server **102** and the full synchronized data set may be resident on the server **102**, laptop **106**, and smart phone **104**. At blocks **1930** and **2824** the laptop computer **106** and server **102** may terminate their communication data link connections with each other. At blocks **2826** and **2828** the smart phone **104** and server **102** may terminate their communication data link connections with each other.

The various embodiments may be implemented in any of a variety of mobile devices, an example of which is illustrated in FIG. **29**. For example, the mobile device **2900** may include a processor **2902** coupled to internal memories **2904** and **2910**. Internal memories **2904** and **2910** may be volatile or non-volatile memories, and may also be secure and/or encrypted memories, or unsecure and/or unencrypted memories, or any combination thereof. The processor **2902** may also be coupled to a touch screen display **2906**, such as a resistive-sensing touch screen, capacitive-sensing touch screen infrared sensing touch screen, or the like. Additionally, the display of the mobile device **2900** need not have touch screen capability. Additionally, the mobile device **2900** may have one or more antenna **2908** for sending and receiving electromagnetic radiation that may be connected to a wireless data link and/or cellular telephone transceiver **2916** coupled to the processor **2902**. The mobile device **2900** may also include physical buttons **2912***a* and **2912***b* for receiving user inputs. The mobile device **2900** may also include a power button **2918** for turning the mobile device **2900** on and off.

The various embodiments may also be implemented on any of a variety of commercially available server devices, such as the server **3000** illustrated in FIG. **30**. Such a server **3000** typically includes a processor **3001** coupled to volatile memory **3002** and a large capacity nonvolatile memory, such as a disk drive **3003**. The server **3000** may also include a floppy disc drive, compact disc (CD) or DVD disc drive **3004** coupled to the processor **3001**. The server **3000** may also include network access ports **3006** coupled to the processor **3001** for establishing network interface connections with a network **3007**, such as a local area network coupled to other broadcast system computers and servers.

The various embodiments described above may also be implemented within a variety of personal computing devices, such as a laptop computer **3110** as illustrated in FIG. **31**. Many laptop computers include a touch pad touch surface **3117** that serves as the computer's pointing device, and thus may receive drag, scroll, and flick gestures similar to those implemented on mobile computing devices equipped with a touch screen display and described above. A laptop computer **3110** will typically include a processor **3111** coupled to volatile memory **3112** and a large capacity nonvolatile memory, such as a disk drive **3113** of Flash memory. The computer **3110** may also include a floppy disc drive **3114** and a compact disc (CD) drive **3115** coupled to the processor **3111**. The computer device **3110** may also include a number of connector ports coupled to the processor **3111** for establishing data connections or receiving external memory devices, such as a USB or FireWire® connector sockets, or other network connection circuits for coupling the processor **3111** to a network. In a notebook configuration, the computer housing includes the touchpad **3117**, the keyboard **3118**, and the display **3119**

all coupled to the processor **3111**. Other configurations of the computing device may include a computer mouse or trackball coupled to the processor (e.g., via a USB input) as are well known, which may also be use in conjunction with the various embodiments.

The processors **2902**, **3001**, and **3111** may be any programmable microprocessor, microcomputer or multiple processor chip or chips that can be configured by software instructions (applications) to perform a variety of functions, including the functions of the various embodiments described above. In some devices, multiple processors may be provided, such as one processor dedicated to wireless communication functions and one processor dedicated to running other applications. Typically, software applications may be stored in the internal memory **2904**, **2910**, **3002**, **3003**, **3112**, and **3113** before they are accessed and loaded into the processor **2902**, **3001**, and **3111**. The processor **2902**, **3001**, and **3111** may include internal memory sufficient to store the application software instructions. In many devices the internal memory may be a volatile or nonvolatile memory, such as flash memory, or a mixture of both. For the purposes of this description, a general reference to memory refers to memory accessible by the processor **2902**, **3001**, and **3111** including internal memory or removable memory plugged into the device and memory within the processor **2902**, **3001**, and **3111** itself.

The foregoing method descriptions and the process flow diagrams are provided merely as illustrative examples and are not intended to require or imply that the steps of the various embodiments must be performed in the order presented. As will be appreciated by one of skill in the art the order of steps in the foregoing embodiments may be performed in any order. Words such as "thereafter," "then," "next," etc. are not intended to limit the order of the steps; these words are simply used to guide the reader through the description of the methods. Further, any reference to claim elements in the singular, for example, using the articles "a," "an" or "the" is not to be construed as limiting the element to the singular.

The various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the embodiments disclosed herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present invention.

The hardware used to implement the various illustrative logics, logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented or performed with a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but, in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration. Alternatively, some steps or methods may be performed by circuitry that is specific to a given function.

In one or more exemplary aspects, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. The steps of a method or algorithm disclosed herein may be embodied in a processor-executable software module which may reside on a tangible, non-transitory computer-readable storage medium. Tangible, non-transitory computer-readable storage media may be any available media that may be accessed by a computer. By way of example, and not limitation, such non-transitory computer-readable media may comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that may be used to store desired program code in the form of instructions or data structures and that may be accessed by a computer. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk, and blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of non-transitory computer-readable media. Additionally, the operations of a method or algorithm may reside as one or any combination or set of codes and/or instructions on a tangible, non-transitory machine readable medium and/or computer-readable medium, which may be incorporated into a computer program product.

The preceding description of the disclosed embodiments is provided to enable any person skilled in the art to make or use the present invention. Various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without departing from the spirit or scope of the invention. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the following claims and the principles and novel features disclosed herein.

What is claimed is:

1. A method for optimizing data delivery among devices, comprising:

identifying in a first computing device a data set for transmission from the first computing device to a plurality of computing devices connected to the first computing device;

separating the data set into data segments;

determining a geographic location of the plurality of computing devices;

determining by the first computing device that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

assigning by the first computing device a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other;

transmitting from the first computing device to each of the plurality of computing devices that computing device's assigned portion of the data segments;

connecting a second computing device of the plurality of computing devices to a third computing device of the plurality of computing devices; and

exchanging between the second and third computing devices their respective assigned portions of the data segments.

2. The method of claim **1**, further comprising:

assigning an identification (ID) to each data segment;

generating a data segment map; and

transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

3. The method of claim **1**, further comprising:

determining a data set characteristic,

wherein separating the data set into data segments comprises separating the data set into data segments based, at least in part, on the determined data set characteristic.

4. The method of claim **1**, further comprising:

determining a connection bandwidth for each connection between the first computing device and the plurality of computing devices; and

determining a total available bandwidth based on a sum of all the connection bandwidths between the first computing device and the plurality of computing devices,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

5. The method of claim **1**, further comprising:

determining a connection bandwidth for each connection between the first computing device and the plurality of computing devices; and

determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

6. The method of claim **1**, further comprising:

determining a connection type for each connection between the first computing device and the plurality of computing devices;

determining a cost associated with each connection type; and

determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined lowest total download cost.

7. The method of claim **1**, further comprising:

determining when a connection between one of the plurality of computing devices and the first computing device is lost; and

transmitting the data set assigned to the computing device with which the connection was lost from the first computing device to a remaining one or more of the plurality of computing devices connected to the first computing device.

8. The method of claim **1**, further comprising:

determining a device type for each of the plurality of computing devices; and

determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,

wherein transmitting from the first computing device to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises transmitting the determined amount of each data segment to send for that computing device.

9. The method of claim **1**, further comprising determining a user preference setting, wherein assigning a portion of the data segments to each of the plurality of computing devices is based, at least in part, on the determined user preference setting.

10. The method of claim **1**, wherein the plurality of computing devices are mobile devices and the first computing device is a central database server.

11. The method of claim **1**, wherein the data set is comprised of e-mail.

12. The method of claim **1**, further comprising:

determining an initial connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;

determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the first computing device and each of the plurality of computing devices, wherein assigning a portion of the data segments to each of the plurality of computing devices comprises initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;

monitoring a connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;

determining if a change occurs in any connection bandwidth for each connection between the first computing device and each of the plurality of computing devices; and

if a change occurs in the connection bandwidth between the first computing device and any of the plurality of computing devices,

determining an updated connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;

determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the first computing device and each of the plurality of computing devices;

reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and

transmitting from the first computing device to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

13. The method of claim **1**, wherein exchanging between the second and third computing device their respective assigned portions of the data segments further comprises:

transmitting a data waiting message from the second computing device to the third computing device; and

transmitting a data segment map from the second computing device to the third computing device.

14. The method of claim **13**, wherein exchanging between the second and third computing device their respective assigned portions of the data segments further comprises:

receiving the data segment map at the third computing device;

determining if any data segments are required by the third computing device based on a comparison of the data segment map and a data set resident on the third computing device; and

transmitting a data segment request from the third computing device to the second computing device and transmitting a requested data segment from the second computing device to the third computing device when it is determined that data segments are required by the third computing device.

15. The method of claim **14**, wherein exchanging between the second and third computing device their respective assigned portions of the data segments further comprises translating data in a requested data segment from a first application format to a second application format before transmitting the requested data segment from one computing device to the other computing device.

16. A system for optimizing data delivery, comprising:

a first computing device; and

a plurality of computing devices connected to the first computing device, the plurality of computing devices comprising at least a second computing device connected to a third computing device,

wherein the first computing device is configured with processor-executable instructions to perform operations comprising:

identifying a data set for transmission from the first computing device to the plurality of computing devices connected to the first computing device;

separating the data set into data segments;

determining a geographic location of each of the plurality of computing devices;

determining that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

assigning a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other; and

transmitting to each of the plurality of computing devices that computing device's assigned portion of the data segments,

wherein the plurality of computing devices are configured with processor-executable instructions to perform operations comprising exchanging between each other their respective assigned portions of the data segments.

17. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

assigning an identification (ID) to each data segment;

generating a data segment map; and

transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

18. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a data set characteristic,

wherein separating the data set into data segments comprises separating the data set into data segments based, at least in part, on the determined data set characteristic.

19. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a connection bandwidth for each connection between the first computing device and each of the plurality of computing devices; and

determining a total available bandwidth based on a sum of all the connection bandwidths between the first computing device and the plurality of computing devices,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

20. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a connection bandwidth for each connection between the first computing device and each of the plurality of computing devices; and

determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

21. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a connection type for each connection between the first computing device and each of the plurality of computing devices;

determining a cost associated with each connection type; and

determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined lowest total download cost.

22. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining when a connection between one of the plurality of computing devices and the first computing device is lost; and

transmitting the data set assigned to the computing device with which the connection was lost from the first computing device to a remaining one or more of the plurality of computing devices connected to the first computing device.

23. The system of claim **16**, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a device type for each of the plurality of computing devices; and

determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,

wherein transmitting from the first computing device to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises transmitting the determined amount of each data segment to send for that computing device.

24. The system of claim 16, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining a user preference setting,

wherein assigning a portion of the data segments to each of the plurality of computing devices is based, at least in part, on the determined user preference setting.

25. The system of claim 16, wherein the plurality of computing devices are mobile devices and the first computing device is a central database server.

26. The system of claim 16, wherein the data set is comprised of e-mail.

27. The system of claim 16, wherein the first computing device is configured with processor-executable instructions to perform operations further comprising:

determining an initial connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;

determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the first computing device and the plurality of computing devices, wherein assigning a portion of the data segments to each of the plurality of computing devices comprises initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;

monitoring a connection bandwidth for each connection between the first computing device and the plurality of computing devices;

determining if a change occurs in connection bandwidth for each connection between the first computing device and any one or more of the plurality of computing devices; and

if a change occurs in the connection bandwidth for each connection between the first computing device and any of the plurality of computing devices,

determining an updated connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;

determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the first computing device and each of the plurality of computing devices;

reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and

transmitting from the first computing device to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

28. The system of claim 16, wherein each of the plurality of computing devices is configured with processor-executable instructions to perform operations further comprising:

transmitting a data waiting message to each other of the plurality of computing devices; and

transmitting a data segment map to the each other of the plurality of computing devices.

29. The system of claim 28, wherein the each of the plurality of devices is configured with processor-executable instructions to perform operations further comprising:

receiving the data segment map from respective others of the plurality of computing devices;

for each received data segment map determining if any data segments are required based on a comparison of the data segment map to data resident on the computing device;

transmitting a data segment request to the respective other of the plurality of computing devices providing the data segment map when it is determined that a data segment is required,

receiving a data segment request from another of the plurality of computing devices; and

transmitting requested data segments to the another of the plurality of computing devices in response to the received data segment request.

30. The system of claim 29, wherein each of the plurality of computing devices is configured with processor-executable instructions to perform operations further comprising:

translating data in a requested data segment from a first application format to a second application format before transmitting the requested data segment to another of the plurality of computing devices.

31. A system for optimizing data delivery, comprising:

means for identifying in a first computing device a data set for transmission from the first computing device to a plurality of computing devices connected to the first computing device;

means for separating the data set into data segments;

means for determining a geographic location of each of the plurality of computing devices;

means for determining in the first computing device that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

means for assigning by the first computing device a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other;

means for transmitting from the first computing device to each of the plurality of computing devices that computing device's assigned portion of the data segments;

means for exchanging between each of the plurality of computing devices their respective assigned portions of the data segments.

32. The system of claim 31, further comprising:

means for assigning an identification (ID) to each data segment;

means for generating a data segment map; and

means for transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

33. The system of claim 31, further comprising:

means for determining a data set characteristic,

wherein means for separating the data set into data segments comprises means for separating the data set into data segments based, at least in part, on the determined data set characteristic.

34. The system of claim 31, further comprising:

means for determining a connection bandwidth for each connection between the first computing device and each of the plurality of computing devices; and

means for the determining a total available bandwidth based on a sum of all the connection bandwidths between the first computing device and the plurality of computing devices,

wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

35. The system of claim 31, further comprising:
means for determining a connection bandwidth for each connection between the first computing device and each of the plurality of computing devices; and
means for determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,
wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

36. The system of claim 31, further comprising:
means for determining a connection type for each connection between the first computing device and each of the plurality of computing devices;
means for determining a cost associated with each connection type; and
means for determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,
wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning data segments to each of the plurality of computing devices based on the determined lowest total download cost.

37. The system of claim 31, further comprising:
means for determining when a connection between one of the plurality of computing devices and the first computing device is lost; and
means for transmitting the data set assigned to the computing device with which the connection was lost from the first computing device to a remaining one or more of the plurality of computing devices connected to the first computing device.

38. The method of claim 31, further comprising:
means for determining a device type for each of the plurality of computing devices; and
means for determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,
wherein means for transmitting from the first computing device to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises means for transmitting the determined amount of each data segment to send for that computing device.

39. The system of claim 31, further comprising means for determining a user preference setting, wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning a portion of the data segments to each of the plurality of computing devices based, at least in part, on the determined user preference setting.

40. The system of claim 31, wherein the plurality of computing devices are mobile devices and the first computing device is a central database server.

41. The system of claim 31, wherein the data set is comprising e-mail.

42. The system of claim 31, further comprising:
means for means for determining an initial connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;
means for determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the first computing device and the plurality of computing devices, wherein assigning a portion of the data segments to each of the plurality of computing devices comprises initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;
means for monitoring a connection bandwidth for each connection between the first computing device and the plurality of computing devices;
means for determining if a change occurs in connection bandwidth for each connection between the first computing device and any of the plurality of computing devices; and
if a change occurs in the connection bandwidth for each connection between the first computing device and any of the plurality of computing devices,
means for determining an updated connection bandwidth for each connection between the first computing device and each of the plurality of computing devices;
means for determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the first computing device and each of the plurality of computing devices;
means for reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and
means for transmitting from the first computing device to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

43. The system of claim 31, wherein means for exchanging between each of the plurality of computing devices their respective assigned portions of the data segments further comprises:
means for transmitting a data waiting message from each of the plurality of computing devices; and
means for transmitting a data segment map from each of the plurality of computing devices to the other of the plurality of computing devices.

44. The system of claim 43, wherein means for exchanging between each of the plurality of computing devices their respective assigned portions of the data segments further comprises:
means for receiving in each of the plurality of computing devices the data segment map from respective others of the plurality of computing devices;
means for determining in each of the plurality of computing devices if any data segments are required based on a comparison of the data segment map to data resident on the computing device;
means for transmitting a data segment request to the respective others of the plurality of computing devices providing the data segment map when it is determined that a data segment is required; and
means for transmitting requested data segments to a requesting computing device in response to receiving a data segment request.

45. The system of claim 44, means for exchanging between each of the plurality of computing devices their respective assigned portions of the data segments further comprises means for translating data in a requested data segment from a first application format to a second application format before

transmitting the requested data segment to another of the plurality of computing devices.

46. A server, comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured with processor-executable instructions to perform operations comprising:

identifying in the server a data set for transmission from the server to a plurality of computing devices;

separating the data set into data segments;

determining a geographic location of each of the plurality of computing devices;

determining that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

assigning a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other;

assigning an identification (ID) to each data segment;

generating a data segment map;

transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments; and

transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

47. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a data set characteristic,

wherein separating the data set into data segments comprises separating the data set into data segments based, at least in part, on the determined data set characteristic.

48. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

determining a total available bandwidth based on a sum of all the connection bandwidths between the server and the plurality of computing devices,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

49. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

50. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a connection type for each connection between the server and each of the plurality of computing devices;

determining a cost associated with each connection type; and

determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality computing devices based on the determined lowest total download cost.

51. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining when a data connection between the server and one of the plurality of computing devices is lost; and

transmitting the data set assigned to the computing device with which the connection was lost from the server to a remaining one or more of the plurality of computing devices connected to the server.

52. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a device type for each of the plurality of computing devices; and

determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,

wherein transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises transmitting the determined amount of each data segment to send for that computing device.

53. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining a user preference setting, wherein assigning a portion of the data segments to each of the plurality of computing devices is based, at least in part, on the determined user preference setting.

54. The server of claim **46**, wherein the data set comprises e-mail.

55. The server of claim **46**, wherein the processor is configured with processor-executable instructions to perform operations further comprising:

determining an initial connection bandwidth for each connection between the server and each of the plurality of computing devices;

determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the server and the plurality of computing devices, wherein assigning a portion of the data segments to each of the plurality of computing devices comprises initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;

monitoring a connection bandwidth for each connection between the server and the plurality of computing devices;

determining if a change occurs in connection bandwidth for each connection between the server and any of the plurality of computing devices; and

if a change occurs in the connection bandwidth for each connection between the server and the plurality of computing devices,

determining an updated connection bandwidth for each connection between the server and the plurality of computing devices;

determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the server and each of the plurality of computing devices;

reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and

transmitting from the server to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

56. A server for optimizing data delivery, comprising:

means for identifying in the server a data set for transmission from the server to a plurality of computing devices;

means for separating the data set into data segments;

means for determining a geographic location of each of the plurality of computing devices;

means for determining that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

means for assigning a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other;

means for assigning an identification (ID) to each data segment;

means for generating a data segment map

means for transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments; and

means for transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

57. The server of claim **56**, further comprising:

means for determining a data set characteristic,

wherein means for separating the data set into data segments comprises means for separating the data set into data segments based, at least in part, on the determined data set characteristic.

58. The server of claim **56**, further comprising:

means for determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

means for determining a total available bandwidth based on a sum of all the connection bandwidths between the server and the plurality of computing devices,

wherein assigning a portion of the data segments to each of the plurality of devices comprises assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

59. The server of claim **56**, further comprising:

means for determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

means for determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,

wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

60. The server of claim **56**, further comprising:

means for determining a connection type for each connection between the server and each of the plurality of computing devices;

means for determining a cost associated with each connection type; and

means for determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,

wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for assigning data segments to each of the plurality of computing devices based on the determined lowest total download cost.

61. The server of claim **56**, further comprising:

means for determining when a data connection between the server and one of the plurality of computing devices is lost; and

means for transmitting the data set assigned to the computing device with which the connection was lost from the server to a remaining one or more of the plurality of computing devices connected to the server.

62. The server of claim **56**, further comprising:

means for determining a device type for each of the plurality of computing devices; and

means for determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,

wherein means for transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises means for transmitting the determined amount of each data segment to send for that computing device.

63. The server of claim **56**, further comprising means for determining a user preference setting, wherein means for assigning a portion of the data segments to each of the plurality of computing devices is based, at least in part, on the determined user preference setting.

64. The server of claim **56**, wherein the data set comprises e-mail.

65. The server of claim **56**, further comprising:

means for determining an initial connection bandwidth for each connection between the server and the plurality of computing devices;

means for determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the server and the plurality of computing devices, wherein means for assigning a portion of the data segments to each of the plurality of computing devices comprises means for initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;

means for monitoring a connection bandwidth for each connection between the server and the plurality of computing devices;

means for determining if a change occurs in connection bandwidth for each connection between the server and any of the plurality of computing devices;

means for determining an updated connection bandwidth for each connection between the server and the plurality of computing devices if a change occurs in the connection bandwidth for each connection between the server and the plurality of computing devices;

means for determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the server and each of the plurality of computing devices;

means for reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and

means for transmitting from the server to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

66. A non-transitory processor-readable medium having stored thereon processor-executable instructions configured to cause a server processor to perform operations comprising:

identifying in a server a data set for transmission from the server to a plurality of computing devices;

separating the data set into data segments;

determining a geographic location of each of the plurality of computing devices;

determining that the plurality of computing devices are within a threshold distance from each other based on the determined geographic locations;

assigning a portion of the data segments to each of the plurality of computing devices in response to determining that the plurality of computing devices are within the threshold distance from each other;

assigning an identification (ID) to each data segment;

generating a data segment map;

transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments; and

transmitting the data segment map to each of the plurality of computing devices,

wherein the data segment map comprises each data segment's ID and data segment assignment information.

67. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a data set characteristic,

wherein separating the data set into data segments comprises separating the data set into data segments based, at least in part, on the determined data set characteristic.

68. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

determining a total available bandwidth based on a sum of all the connection bandwidths between the server and the plurality of computing devices,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices in proportion to each computing device's connection bandwidth as a percentage of the determined total available bandwidth.

69. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a connection bandwidth for each connection between the server and each of the plurality of computing devices; and

determining data segment assignments among the plurality of computing devices that will result in a shortest estimated download time,

wherein assigning a portion of the data segments to each of the plurality of computing devices comprises assigning data segments to each of the plurality of computing devices based on the determined shortest estimated download time.

70. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a connection type for each connection between the server and each of the plurality of computing devices;

determining a cost associated with each connection type; and

determining data segment assignments among the plurality of computing devices that will result in a lowest total download cost,

wherein assigning a portion of the data segments to each of the plurality of devices comprises assigning data segments to each of the plurality of computing devices based on the determined lowest total download cost.

71. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining when a data connection between the server and one of the plurality of computing devices is lost; and

transmitting the data set assigned to the computing device with which the connection was lost from the server to a remaining one or more of the plurality of computing devices connected to the server.

72. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a device type for each of the plurality of computing devices; and

determining an amount of each data segment to send to each of the plurality of computing devices based on each computing device's determined device type,

wherein transmitting from the server to each of the plurality of computing devices that computing device's assigned portion of the data segments comprises transmitting the determined amount of each data segment to send for that computing device.

73. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining a user preference setting, wherein assigning a portion of the data segments to each of the plurality of computing devices is based, at least in part, on the determined user preference setting.

74. The non-transitory processor readable medium of claim **66**, wherein the data set comprises e-mail.

75. The non-transitory processor-readable medium of claim **66**, wherein the stored processor-executable instructions are configured to cause a server processor to perform operations further comprising:

determining an initial connection bandwidth for each connection between the server and each of the plurality of computing devices;

determining a total initial available bandwidth based on a sum of all the initial connection bandwidths between the

server and the plurality of computing devices, wherein assigning a portion of the data segments to each of the plurality of computing devices comprises initially assigning data segments to each of the plurality of computing devices in proportion to each computing device's initial connection bandwidth as a percentage of the total initial available bandwidth;

monitoring a connection bandwidth for each connection between the server and the plurality of computing devices;

determining if a change occurs in connection bandwidth for each connection between the server and any one of the plurality of computing devices; and

if a change occurs in the connection bandwidth for each connection between the server and the plurality of computing devices,

determining an updated connection bandwidth for each connection between the server and the plurality of computing devices;

determining a total updated available bandwidth based on a sum of all the updated connection bandwidths between the server and each of the plurality of computing devices;

reassigning data segments to each of the plurality of computing devices in proportion to each computing device's updated connection bandwidth as a percentage of the total updated available bandwidth; and

transmitting from the server to each of the plurality of computing devices that computing device's reassigned portion of the data segments.

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